The ALBA Synchrotron maintenance approach

Lluís Miralles

CELLS Engineering Division Head

Talk outline

- Overview of ALBA Building and utilities.
- Building and utilities current maintenance approach.
- Vacuum systems current maintenance approach
- Condition Based Maintenance introduction study

Talk outline

- **Overview of ALBA Building and utilities.**
- Building and utilities current maintenance approach.
- Vacuum systems current maintenance approach
- Condition Based Maintenance introduction study

ALBA site


North Atlantic Ocean
© 2011 Europa Technologies
© 2011 Tele Atlas
US Dept of State Geographer
© 2011 Google
Google
41°29'01.97" N 2°06'39.87" E elev 34 m
Eye alt 5445.15 km

ALBA site

ALBA Site

ALBA Site

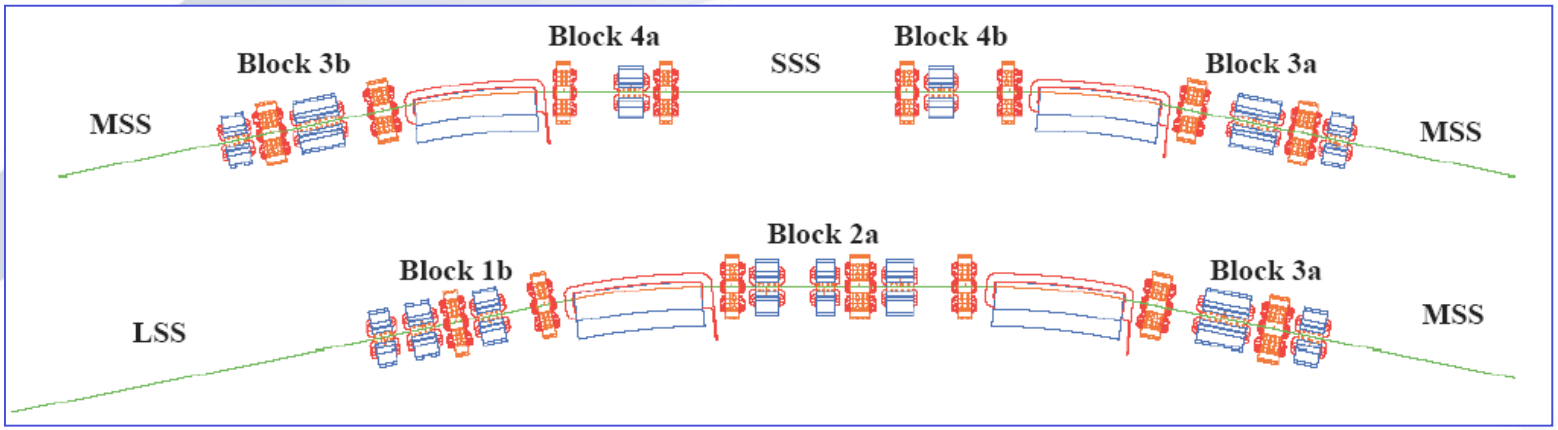
ALBA Site

Lattice

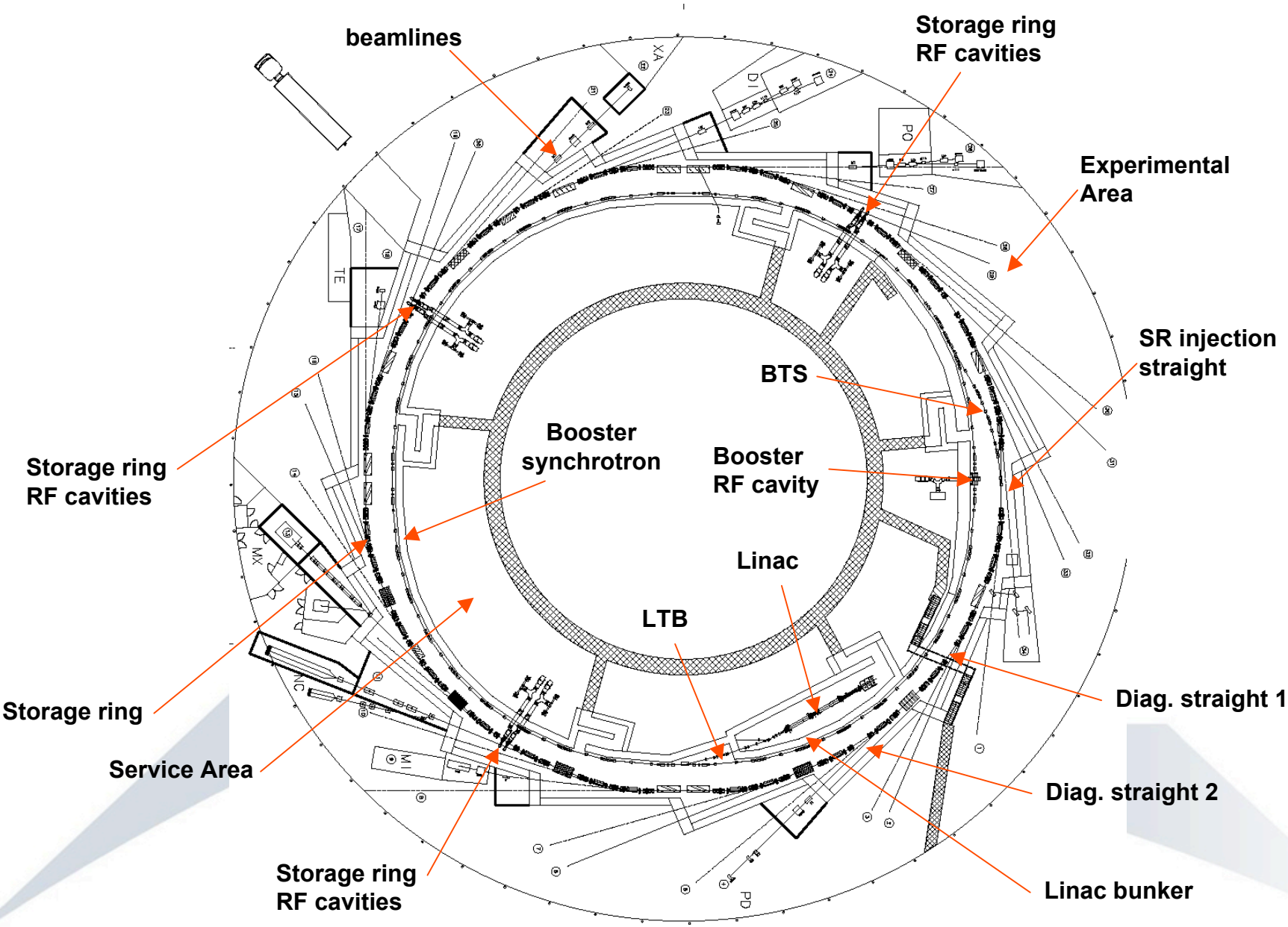
Energy	GeV	3.0
Nominal current	mA	250
Design current	mA	400
Horizontal Emittance	nm.rad	4.3
Lattice		Expanded DBA
Storage ring Circumference	m	268.8
No. of dipoles		32
Bending angle	mrad	196.34
Radius of curvature	m	7.047042
Dipole magnetic field	T	1.42
Critical energy from dipole	keV	8.5
Total photon flux at the design current	Ph/sec	$9.7 \cdot 10^{20}$
Total power at the design current	kW	407
Harmonic number		448
Frequency	MHz	500
Momentum Compaction Factor		$8.8 \cdot 10^{-4}$
Chromaticity (Horizontal/Vertical)		-39.8/-25.6

Unit Cell

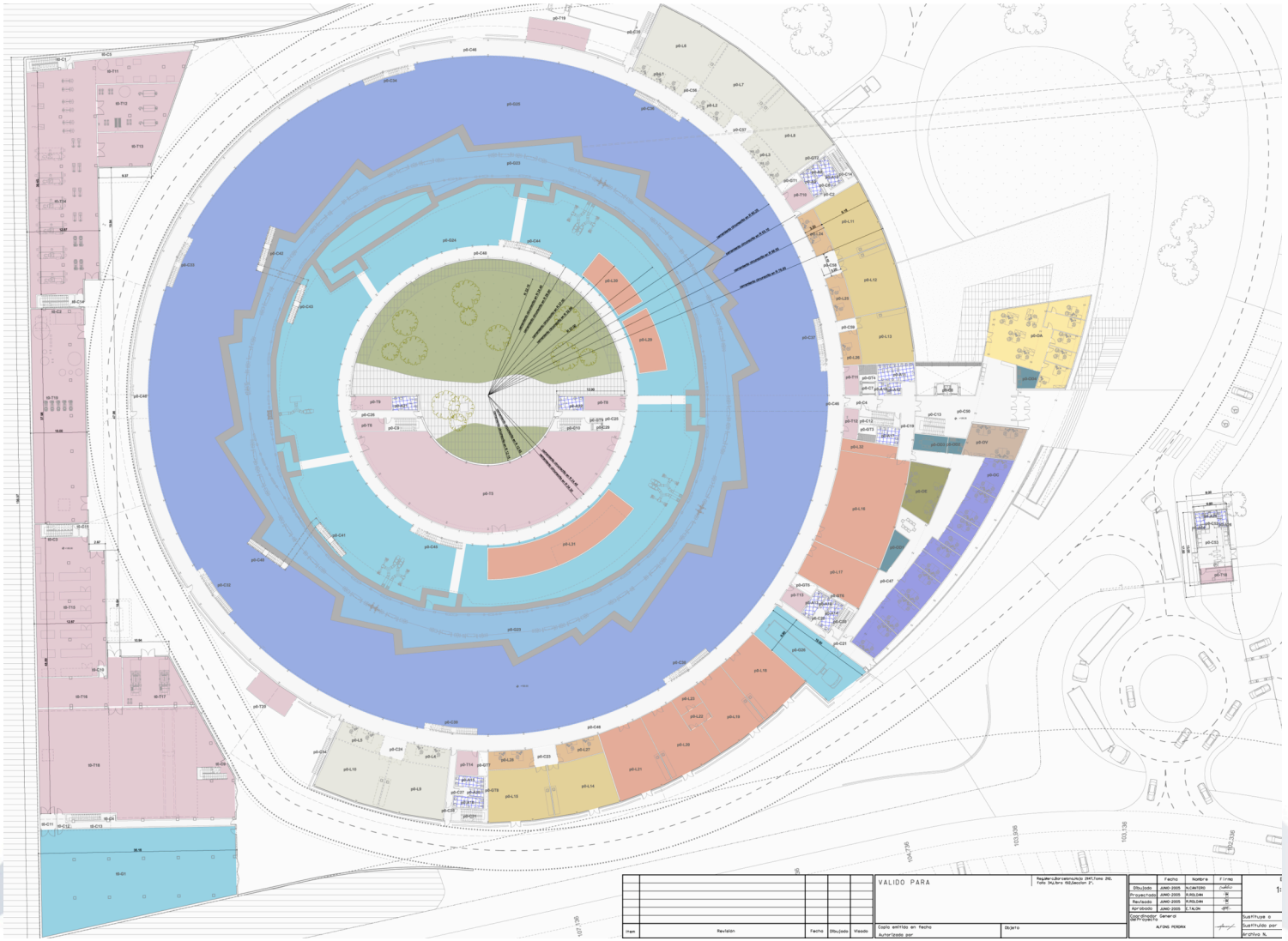
Matching Cell



Accelerators layout



ALBA Site



MAIN ENERGY PRODUCTION

•THERE ARE THREE ENERGY CIRCUITS:
- COOLING WATER, AT 7±05°C
- HOT WATER, AT 50±1°C
- DEIONIZED WATER, AT 23±0.2°C

THERE IS AN EXTERNAL POWER PLANT, REDUNDANT 100% LOCATED NEAR THE SITE, CALLED ST4 POLYCOGENERATION IS A DHC (DISTRICT HEATING AND COOLING)
POSSIBILITY OF SWITCHING FROM ONE SYSTEM TO THE OTHER INTERNAL PRODUCTION OR EXTERNAL PRODUCTION COGENERATION PLANT.

Some figures:
Cooling power: 8,750 kW
Heating power: 1,400 kW

CHILLED WATER PRODUCTION

-CONDENSATION OF THESE MACHINES HAS BEEN MADE WITH 8 OPEN COOLING TOWERS **1,250 kW** EACH.

-THIS CHILLED WATER PRODUCTION IS USED TO COOL WATER THROUGH TWO PRIMARY PLATE EXCHANGERS (DW), **1,815 kW** EACH.

- TOTAL COOLINGS ARE:
1. THE SOURCE LIGHT **(3,627 kW)**
2. HVAC, HEATING VENTILATION AND AIR CONDITIONING, **(3,245 Kw)**

-COOLING SYSTEM IS MADE BY 4 CONDENSED WATER MACHINES.

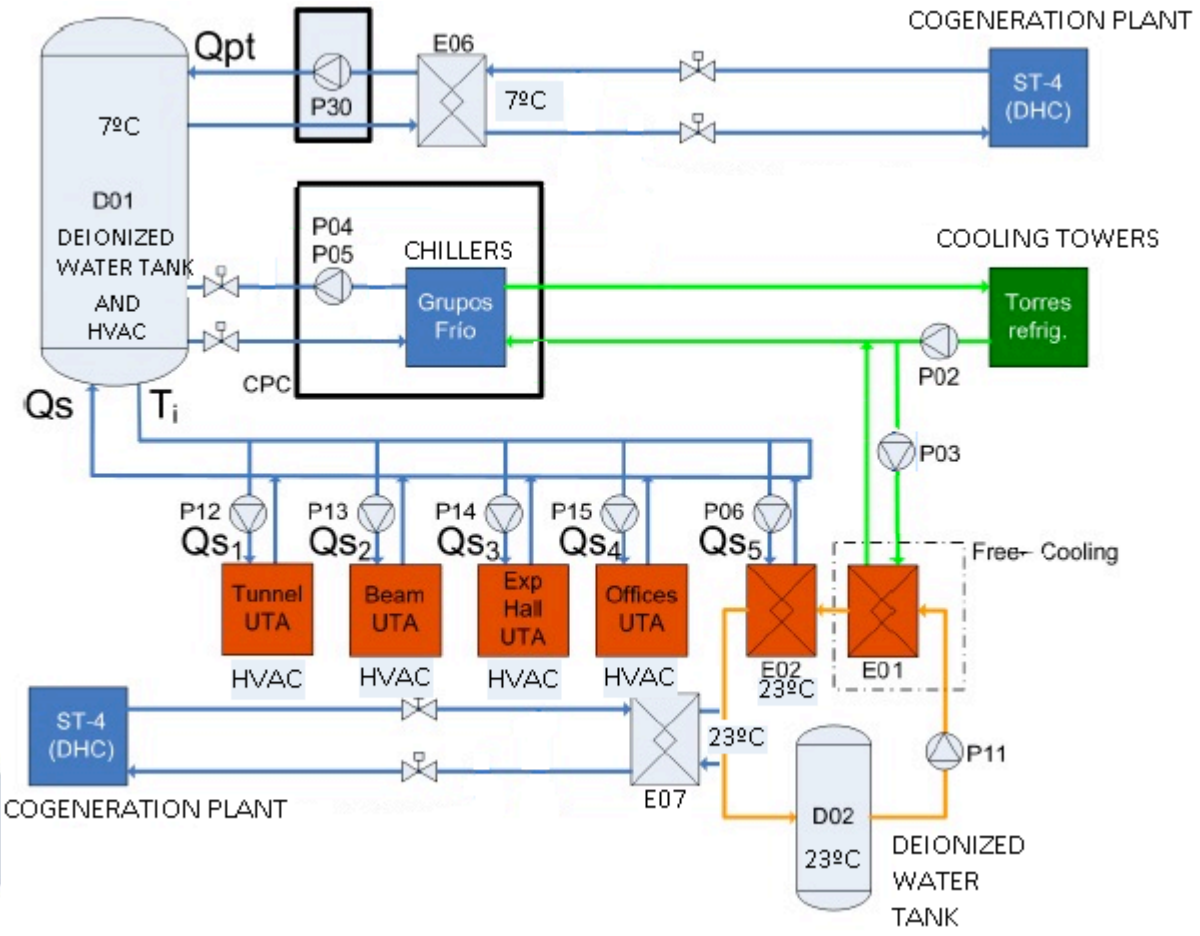
- PRODUCE WATER AT 7ºC:

-2 UNITS: CENTRIFUGAL COMPRESSORS WITH **2,900** kW EACH

-2 UNITS: SCREW COMPRESSORS WITH **1,300 kW** EACH

A TOTAL OF **8,750 KW**

MAIN ENERGY DIAGRAM



- ALBA IS DIRECTLY CONNECTED TO THE 220 KV HIGH VOLTAGE NET.
- THROUGH A 20 MVA TRANSFORMER, THE VOLTAGE IS REDUCED FROM 220 KV TO 25 KV, AND TRANSMITED TO ALBA.
- ALBA HAS 25 KV REDUNDANCY THROUGH A COGENERATION PLANT.
- AT ALBA, THE VOLTAGE IS FINALLY REDUCED FROM HIGH TO LOW VOLTAGE, FROM 25 KV TO 400 V.

220 KV

220 KV/25 KV TRANSFORMER

S.E. CODONYERS
220/25 KV

2 X 25KV

1,8 Km

2 X 25KV

1,8 Km

ALBA

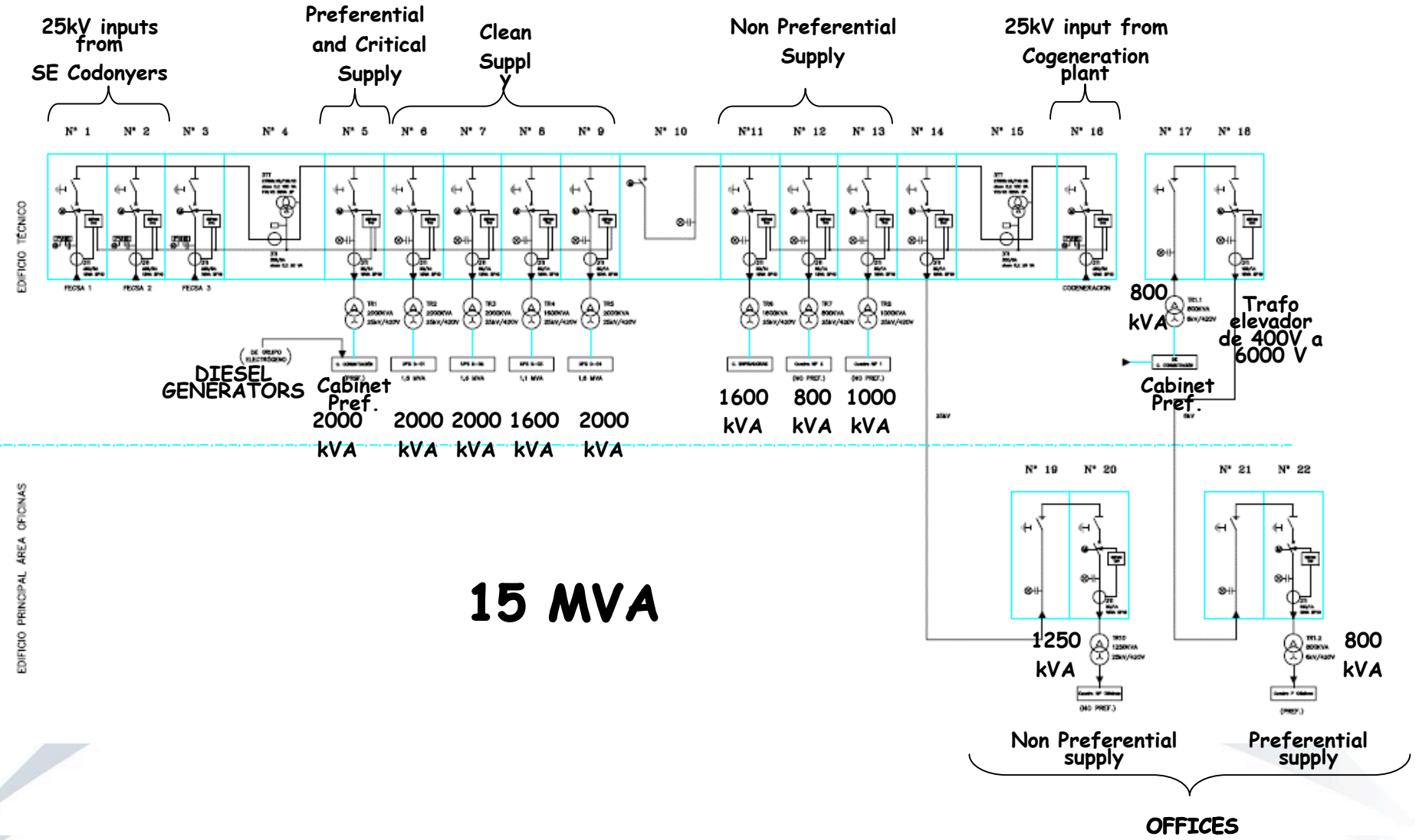
25KV

0,7 Km

ST4 COGENERATION PLANT

11 DRY TYPE TRANSFORMERS

DIFFERENT POWERS (From 0,8 to 2 MVA)


25kV inputs from SE Codonyers
Preferential and Critical Supply
Clean Suppl y
Non Preferential Supply
25kV input from Cogeneration plant
N° 1
N° 2
N° 3
N° 4
N° 5
N° 6
N° 7
N° 8
N° 9
N° 10
N°11
N° 12
N° 13
N° 14
N° 15
N° 16
N° 17
N° 18
EDIFICIO TÉCNICO
DIESEL GENERATORS
Cabinet Pref.
2000 kVA
2000 kVA
2000 kVA
1600 kVA
2000 kVA
1600 kVA
800 kVA
1000 kVA
800 kVA
Trafo elevador de 400V a 6000 V
Cabinet Pref.
15 MVA
EDIFICIO PRINCIPAL ÁREA OFICINAS
N° 19
N° 20
N° 21
N° 22
1250 kVA
800 kVA
Non Preferential supply
Preferential supply
OFFICES

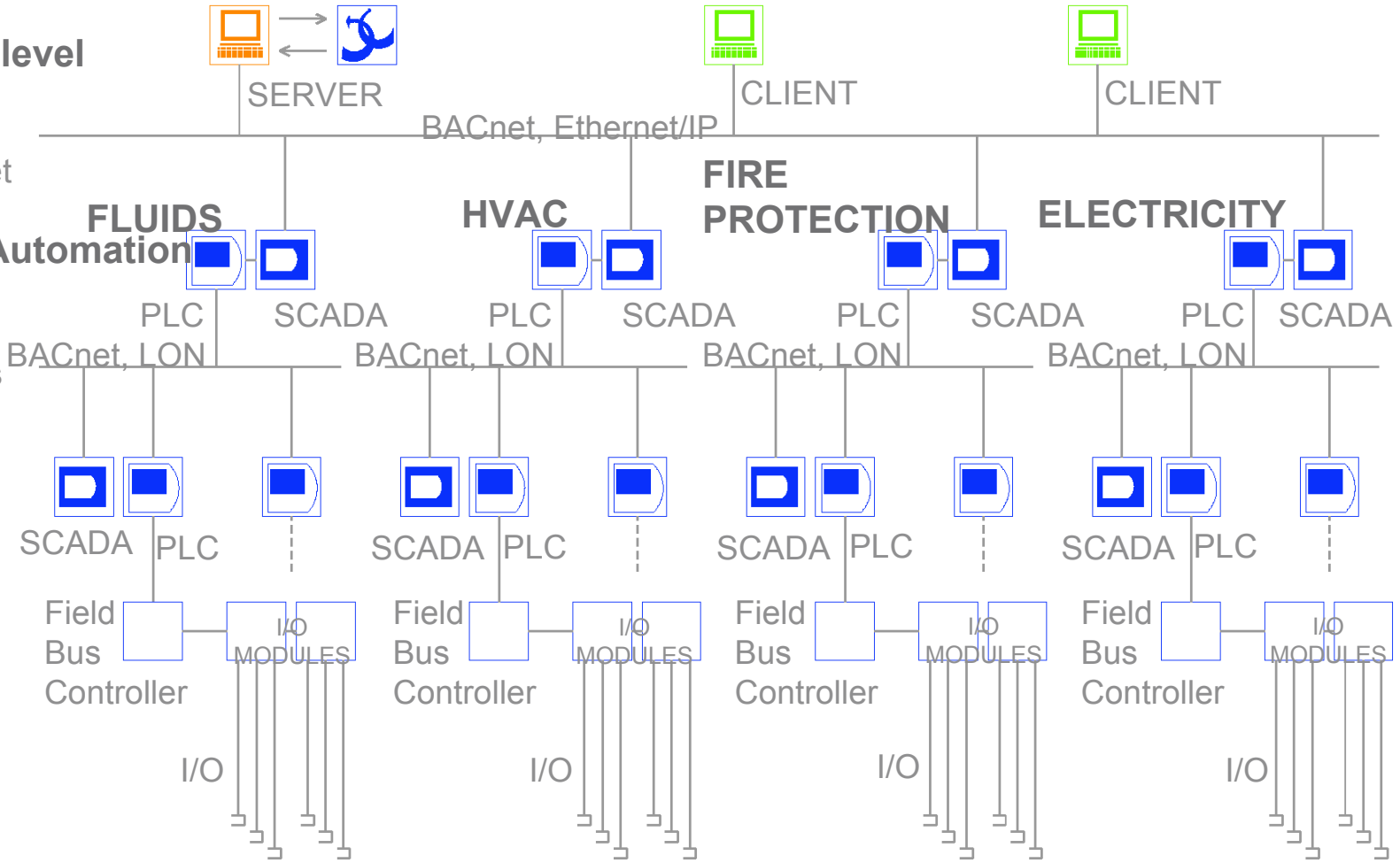
CENTRALIZED CONTROL OF INSTALATIONS - ARCHITECTURE

Management level
1. Server
2. Clients
3. Lan/Ethernet controllers

Global level Automation
1. PLC
2. SCADA
3. BACnet Bus
4. LON mark

Local level Automation

Field level
1. Values
2. Inverters
3. Sensors
4. Indicators



Talk outline

- Overview of ALBA Building and utilities.
- **Building and utilities current maintenance approach.**
- Vacuum systems current maintenance approach
- Condition Based Maintenance introduction study

Objective. Maximum reliability at minimum cost

Strategy

Keep in-house all knowledge necessary to operate and maintain the facility.

In-house management of the maintenance of the facility.

Optimize the maintenance cost related to personnel, spares and reposition.

Scheme

Team of in-house technicians (2) and engineers (4) trained and educated on all the disciplines related with maintenance.

Outsourcing to specialized companies the routine and normative maintenance of specific equipments. Corrective in function of volume.

Spares and components supply framework conditions with general and specialist suppliers (price and delivery time).

Outsourcing personnel support for preventive and routine corrective maintenance (2+1 FTE). Flexibility on the contract in order to absorb peak loads.

ALBA Operations Calendar, January 2013-December 2013

BL operation	BL	BL days
Start-up	M	Machine days
Warm-up	W	warm-up time Linac & RF & magnets & sub-systems optimisation
Shutdown	Off	Civil Engineering, Accelerators and BL maintenance with no beam, installations and upgrades

	January				February				March				April				May				June				July				August				September				October				November				December			
			Shift				Shift				Shift				Shift				Shift				Shift				Shift				Shift				Shift				Shift				Shift				Shift			
Weekday	Day	Week	M	A	N	Day	Week	M	A	N	Day	Week	M	A	N	Day	Week	M	A	N	Day	Week	M	A	N	Day	Week	M	A	N	Day	Week	M	A	N	Day	Week	M	A	N	Day	Week	M	A	N	Day	Week	M	A	N
Mo		1														1	14	W	W	W										1	27	M	M	M																	
Tu	1		Off	Off	Off											2		W	W	W										2		M	M	M					1		BL	BL	BL								
We	2		Off	Off	Off											3		W	W	W	1		W	W	W					3		BL	BL	BL					2		BL	BL	BL								
Th	3		Off	Off	Off											4		W	W	W	2		W	W	W					4		BL	BL	BL	1		Off	Off	Off	3		BL	BL	BL								
Fr	4		Off	Off	Off	1		BL	BL	BL	1		BL	BL	BL	5		M	M	M	3		W	W	W					5		BL	BL	BL	2		Off	Off	Off	4		BL	BL	BL	1		BL	BL	BL			
Sa	5		Off	Off	Off	2		BL	BL	BL	2		BL	BL	BL	6		M	M	M	4		W	W	W	1		W	W	W	6		BL	BL	BL	3		Off	Off	Off	5		W	W	W	2		BL	BL	BL			
Su	6		Off	Off	Off	3		BL	BL	BL	3		BL	BL	BL	7		M	M	M	5		W	W	W	2		W	W	W	7		BL	BL	BL	4		Off	Off	Off	6		W	W	W	3		BL	BL	BL	1		BL	BL	BL
Mo	7	2	Off	Off	Off	4	6	M	M	M	4	10	M	M	M	8	15	M	M	M	6	19	M	M	M	3	23	M	M	M	8	28	M	M	M	5	32	Off	Off	Off	2	36	W	W	W	7	41	W	W	W	4	45	M	M	M	2	49	M	M	M
Tu	8		Off	Off	Off	5		BL	BL	BL	5		BL	BL	BL	9		BL	BL	BL	7		M	M	M	4		M	M	M	9		BL	BL	BL	6		Off	Off	Off	3		W	W	W	8		W	W	W	5		BL	BL	BL	3		BL	BL	BL
We	9		Off	Off	Off	6		BL	BL	BL	6		BL	BL	BL	10		BL	BL	BL	8		BL	BL	BL	5		BL	BL	BL	10		BL	BL	BL	7		Off	Off	Off	4		M	M	M	9		W	W	W	6		BL	BL	BL	4		BL	BL	BL
Th	10		W	W	W	7		BL	BL	BL	7		BL	BL	BL	11		BL	BL	BL	9		BL	BL	BL	6		BL	BL	BL	11		BL	BL	BL	8		Off	Off	Off	5		M	M	M	10		W	W	W	7		BL	BL	BL	5		BL	BL	BL
Fr	11		W	W	W	8		BL	BL	BL	8		BL	BL	BL	12		BL	BL	BL	10		BL	BL	BL	7		BL	BL	BL	12		BL	BL	BL	9		Off	Off	Off	6		M	M	M	11		W	W	W	8		BL	BL	BL	6		W	W	W
Sa	12		W	W	W	9		BL	BL	BL	9		BL	BL	BL	13		BL	BL	BL	11		BL	BL	BL	8		BL	BL	BL	13		BL	BL	BL	10		Off	Off	Off	7		M	M	M	12		W	W	W	9		W	W	W	7		W	W	W
Su	13		W	W	W	10		BL	BL	BL	10		BL	BL	BL	14		BL	BL	BL	12		BL	BL	BL	9		BL	BL	BL	14		BL	BL	BL	11		Off	Off	Off	8		M	M	M	13		W	W	W	10		W	W	W	8		W	W	W
Mo	14	3	W	W	W	11	7	M	M	M	11	11	M	M	M	15	16	M	M	M	13	20	M	M	M	10	24	M	M	M	15	29	M	M	M	12	33	Off	Off	Off	9	37	M	M	M	14	42	M	M	M	11	46	W	W	W	9	50	W	W	W
Tu	15		W	W	W	12		BL	BL	BL	12		BL	BL	BL	16		BL	BL	BL	14		BL	BL	BL	11		BL	BL	BL	16		BL	BL	BL	13		Off	Off	Off	10		M	M	M	15		M	M	M	12		W	W	W	10		PSS	PSS	W
We	16		W	W	W	13		BL	BL	BL	13		BL	BL	BL	17		BL	BL	BL	15		BL	BL	BL	12		BL	BL	BL	17		BL	BL	BL	14		Off	Off	Off	11		M	M	M	16		BL	BL	BL	13		W	W	W	11		PSS	PSS	W
Th	17		W	W	W	14		CSN	CSN	W	14		BL	BL	BL	18		BL	BL	BL	16		BL	BL	BL	13		BL	BL	BL	18		BL	BL	BL	15		Off	Off	Off	12		M	M	M	17		BL	BL	BL	14		W	W	W	12		W	W	W
Fr	18		W	W	W	15		CSN	CSN	W	15		BL	BL	BL	19		BL	BL	BL	17		BL	BL	BL	14		BL	BL	BL	19		BL	BL	BL	16		Off	Off	Off	13		M	M	M	18		BL	BL	BL	15		W	W	W	13		W	W	W
Sa	19		W	W	W	16		W	W	W	16		BL	BL	BL	20		BL	BL	BL	18		BL	BL	BL	15		BL	BL	BL	20		BL	BL	BL	17		Off	Off	Off	14		M	M	M	19		BL	BL	BL	16		W	W	W	14		W	W	W
Su	20		W	W	W	17		W	W	W	17		BL	BL	BL	21		BL	BL	BL	19		BL	BL	BL	16		BL	BL	BL	21		BL	BL	BL	18		Off	Off	Off	15		M	M	M	20		BL	BL	BL	17		W	W	W	15		W	W	W
Mo	21	4	M	M	M	18	8	W	W	W	18	12	M	M	M	22	17	M	M	M	20	21	M	M	M	17	25	M	M	M	22	30	M	M	M	19	34	Off	Off	Off	16	38	M	M	M	21	43	M	M	M	18	47	M	M	M	16	51	Off	Off	Off
Tu	22		M	M	M	19		W	W	W	19		BL	BL	BL	23		BL	BL	BL	21		BL	BL	BL	18		BL	BL	BL	23		BL	BL	BL	20		Off	Off	Off	17		BL	BL	BL	22		BL	BL	BL	19		M	M	M	17		Off	Off	Off
We	23		M	M	M	20		W	W	W	20		BL	BL	BL	24		BL	BL	BL	22		BL	BL	BL	19		BL	BL	BL	24		BL	BL	BL	21		Off	Off	Off	18		BL	BL	BL	23		BL	BL	BL	20		BL	BL	BL	18		Off	Off	Off
Th	24		M	M	M	21		W	W	W	21		CSN	CSN	W	25		BL	BL	BL	23		BL	BL	BL	20		BL	BL	BL	25		BL	BL	BL	22		Off	Off	Off	19		BL	BL	BL	24		BL	BL	BL	21		BL	BL	BL	19		Off	Off	Off
Fr	25		M	M	M	22		W	W	W	22		CSN	CSN	W	26		BL	BL	BL	24		BL	BL	BL	21		BL	BL	BL	26		BL	BL	BL	23		W	W	W	20		BL	BL	BL	25		BL	BL	BL	22		BL	BL	BL	20		Off	Off	Off
Sa	26		M	M	M	23		W	W	W	23		W	W	W	27		W	W	W	25		W	W	W	22		W	W	W	27		W	W	W	24		W	W	W	21		BL	BL	BL	26		BL	BL	BL	23		BL	BL	BL	21		Off	Off	Off
Su	27		M	M	M	24		W	W	W	24		W	W	W	28		W	W	W	26		W	W	W	23		W	W	W	28		W	W	W	25		W	W	W	22		BL	BL	BL	27		BL	BL	BL	24		BL	BL	BL	22		Off	Off	Off
Mo	28	5	M	M	M	25	9	M	M	M	25	13	W	W	W	29	18	W	W	W	27	22	W	W	W	24	26	W	W	W	29	31	W	W	W	26	35	W	W	W	23	39	M	M	M	28	44	M	M	M	25	48	M	M	M	23	52	Off	Off	Off
Tu	29		M	M	M	26		M	M	M	26		W	W	W	30		W	W	W	28		W	W	W	25		PSS	PSS	W	30		Off	Off	Off	27		W	W	W	24		BL	BL	BL	29		BL	BL	BL	26		BL	BL	BL	24		Off	Off	Off
We	30		BL	BL	BL	27		BL	BL	BL	27		W	W	W						29		W	W	W	26		PSS	PSS	W	31		Off	Off	Off	28		W	W	W	25		BL	BL	BL	30		BL	BL	BL	27		BL	BL	BL	25		Off	Off	Off
Th	31		BL	BL	BL	28		BL	BL	BL	28		W	W	W						30		W	W	W	27		W	W	W						29		W	W	W	26		BL	BL	BL					28		BL	BL	BL	26		Off	Off	Off
Fr											29		W	W	W						31		W	W	W	28		W	W	W						30		W	W	W	27		BL	BL	BL					29		BL	BL	BL	27		Off	Off	Off
Sa											30		W	W	W										29		W	W	W						31		W	W	W	28		BL	BL	BL					30		BL	BL	BL	28		Off	Off	Off
Su											31		W	W	W										30		W	W	W										29		BL	BL	BL									29		Off	Off	Off
Mo																																										30	40	M	M	M									30		Off	Off	Off
Tu																																																							31		Off	Off	Off
We																																																										
Th																																																										

	2013 (hours)	Ratios (%)	COMMENTS
BL	3600	70.9	7/9 for users
M	1416	27.9	Start-up, FOFB, Top-up
CSN	64	1.3	Nuclear Safety Council
TOTAL OPERATIONS	**5080**		
OFF	1176		Maintenances
W	2440		Maintenances
PSS	64		PSS functional checks
TOTAL NO OPERATIONS	**3680**		
TOTAL HOURS/YEAR	**8760**		

In-house

Preventive and corrective of low voltage, cooling and HVAC distribution.

Preventive and corrective on architecture.

Supervision of all systems on dairy, weekly and monthly basis.

Outsourcing

Medium voltage (25Kv) and high voltage (220Kv)

Low voltage yearly normative

Cranes and elevators normative

Fire extinguishing normative and corrective

Boilers 5 years normative and yearly preventive

Chillers yearly preventive

Cooling towers. Normative follow-up

Dynamic UPS preventive (2/year)

Static UPS yearly preventive

Diesel generators yearly preventive

Compressed air preventive (2/year)

Preventive maintenance approach by CMMS (Computerized Maintenance Management System)

Software PRISMA 3

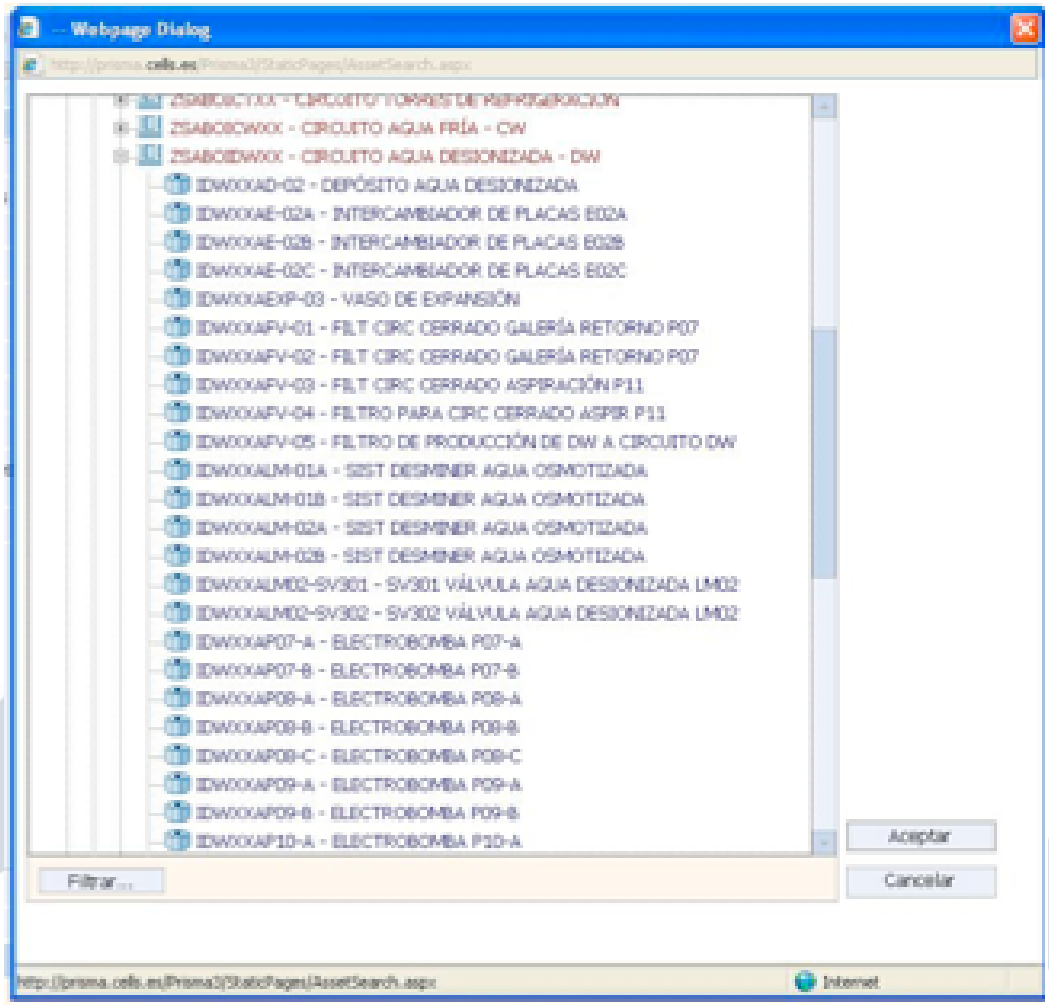
Main reasons driving the choice:

- Availability of the component database from the installation period.
- Experience from installation/exploitation period.
- In-house knowledge
- Widely implemented in industrial and technological environments
- Scalability
- Integration capabilities
- Potentiality
- Maturity

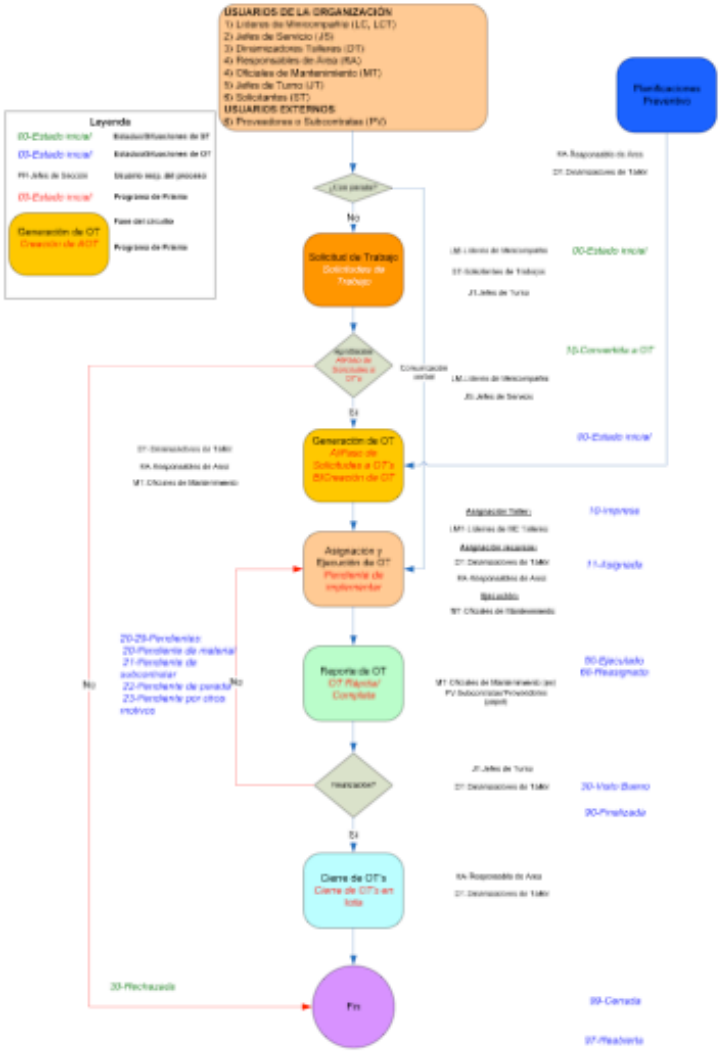
Installation description implemented in 5 levels

- Facility
- Building
- Zone
- System
- Component

Deionized Water System breakdown

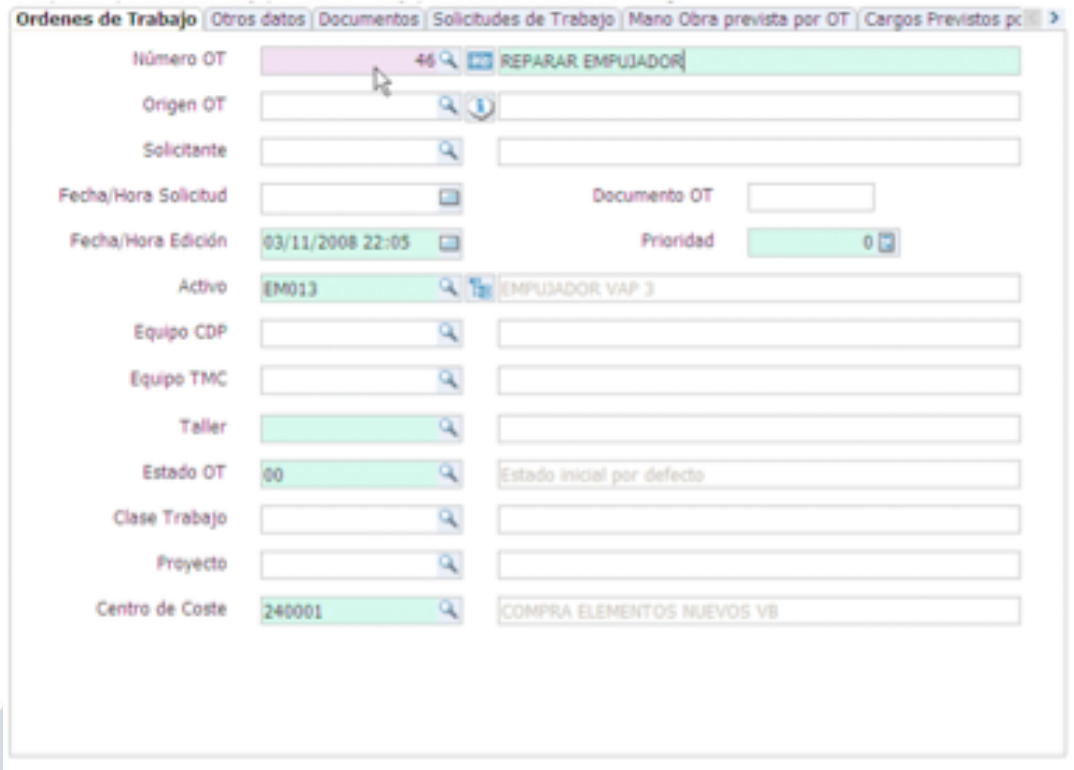


Work Flow in PRISMA. The work order process



Work order generated by user or preventive maintenance program

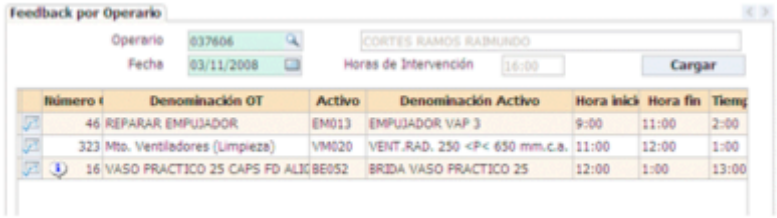
Work order

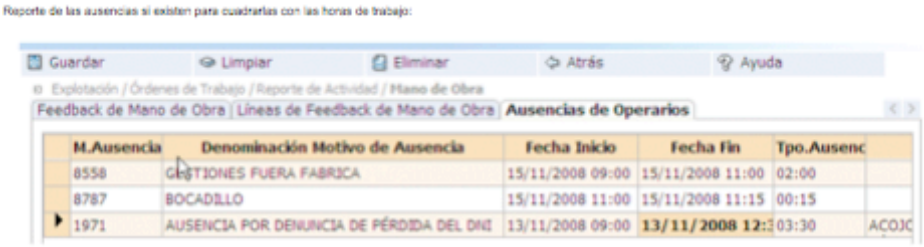


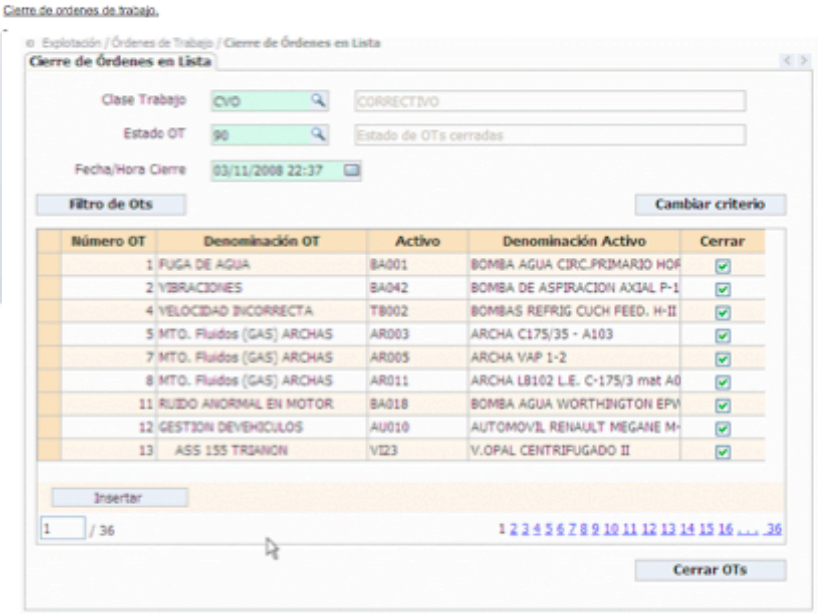
Wide spectra of information can be specified. Manpower and technical information specifications (Drawings, technical instructions, safety instructions, tooling,…)

Work order. Feedback tool

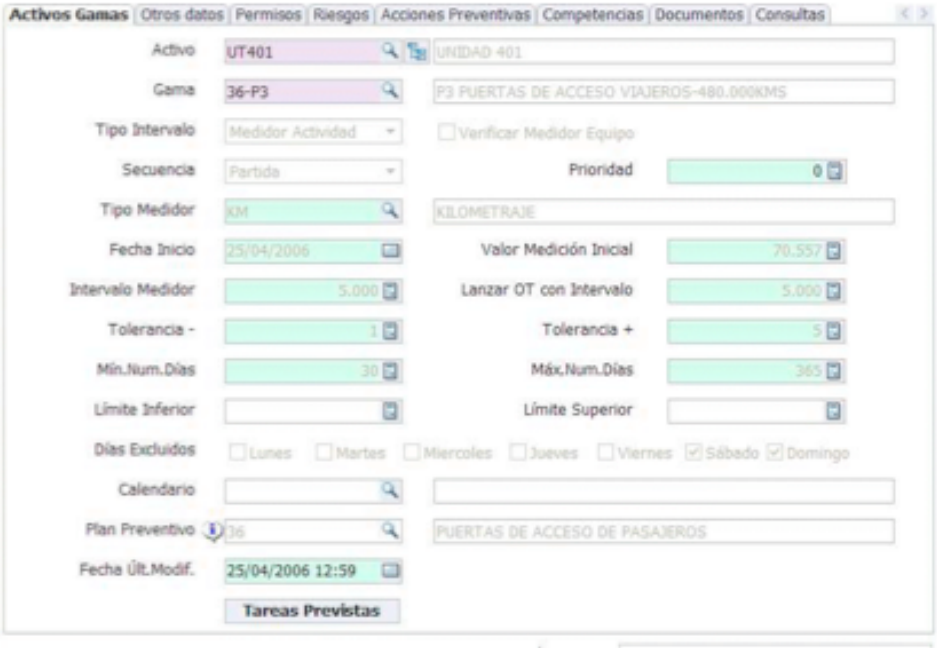
Execution time, incidences, comments,…

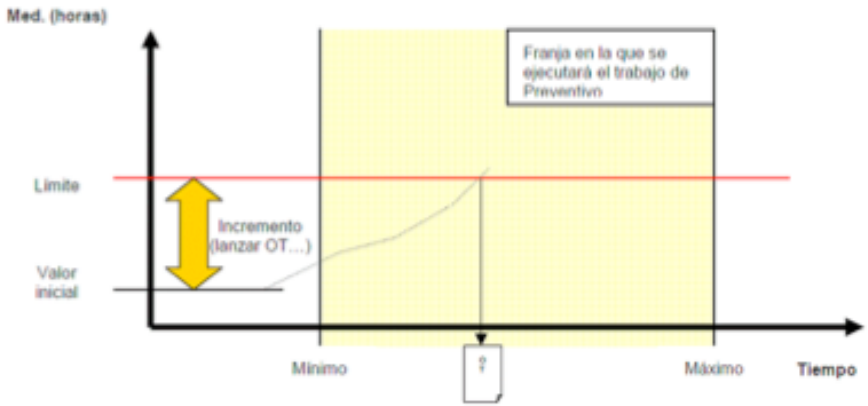




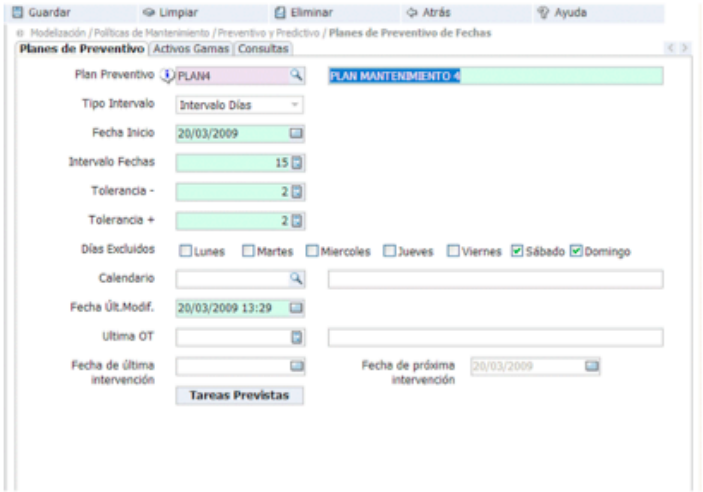


Work order. Generated by trigger





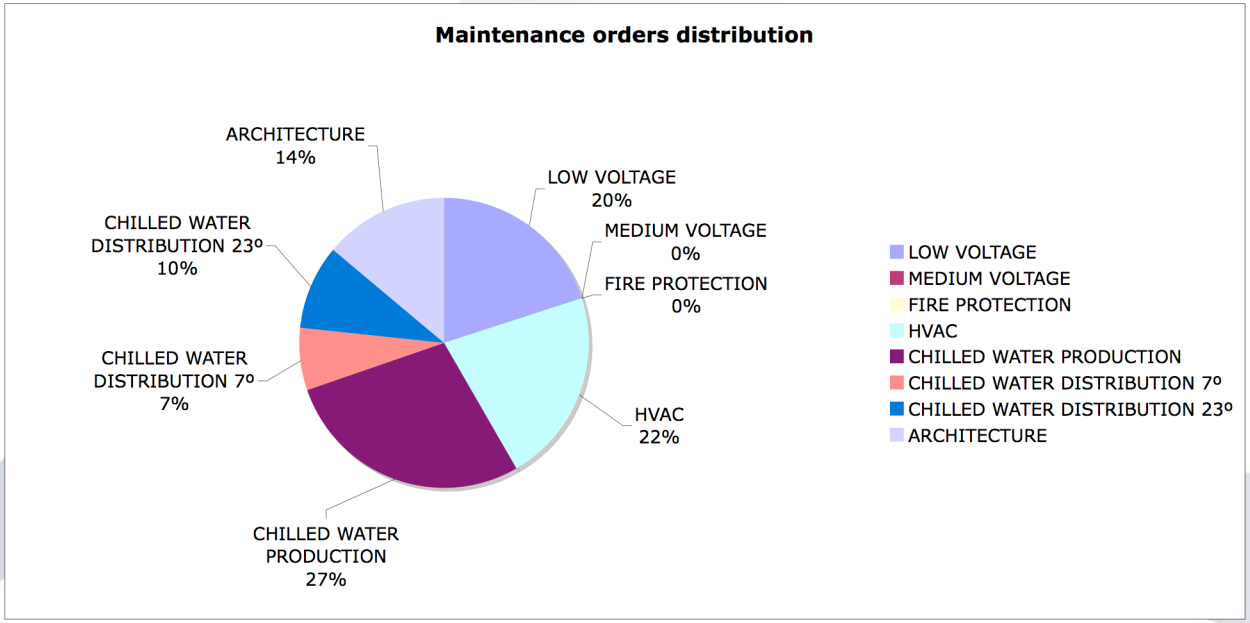
Work order. Generated by schedule



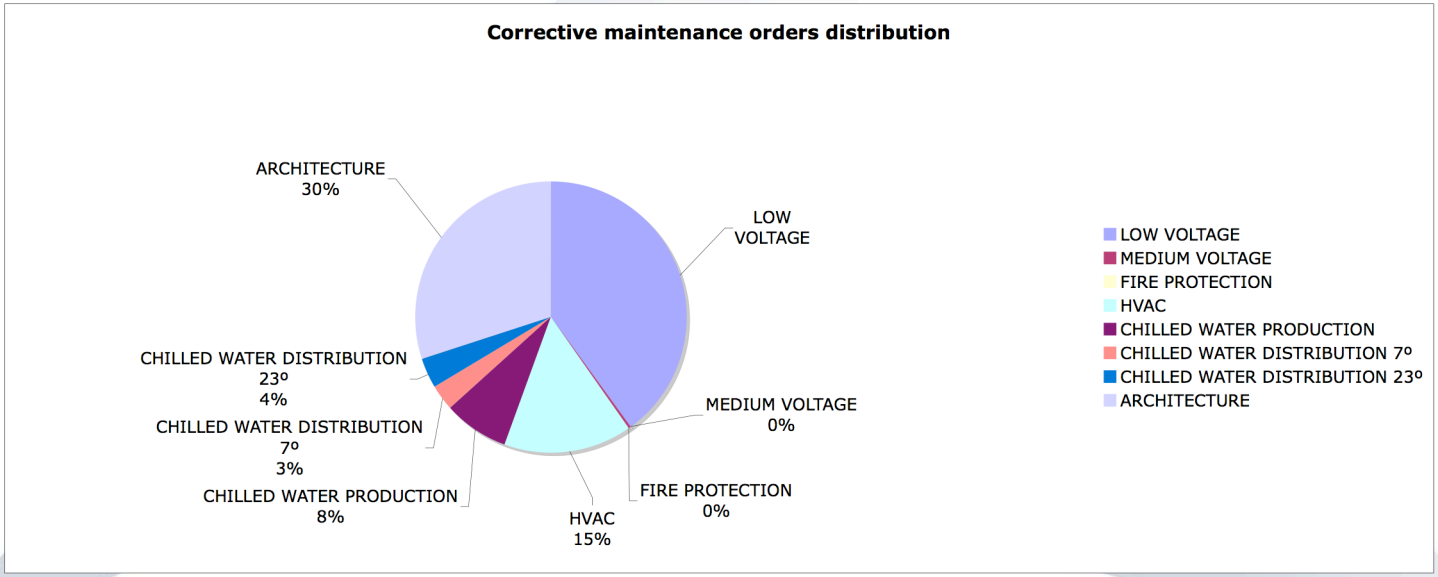
Calendario de acciones preventivas

Ordenes de una planificación

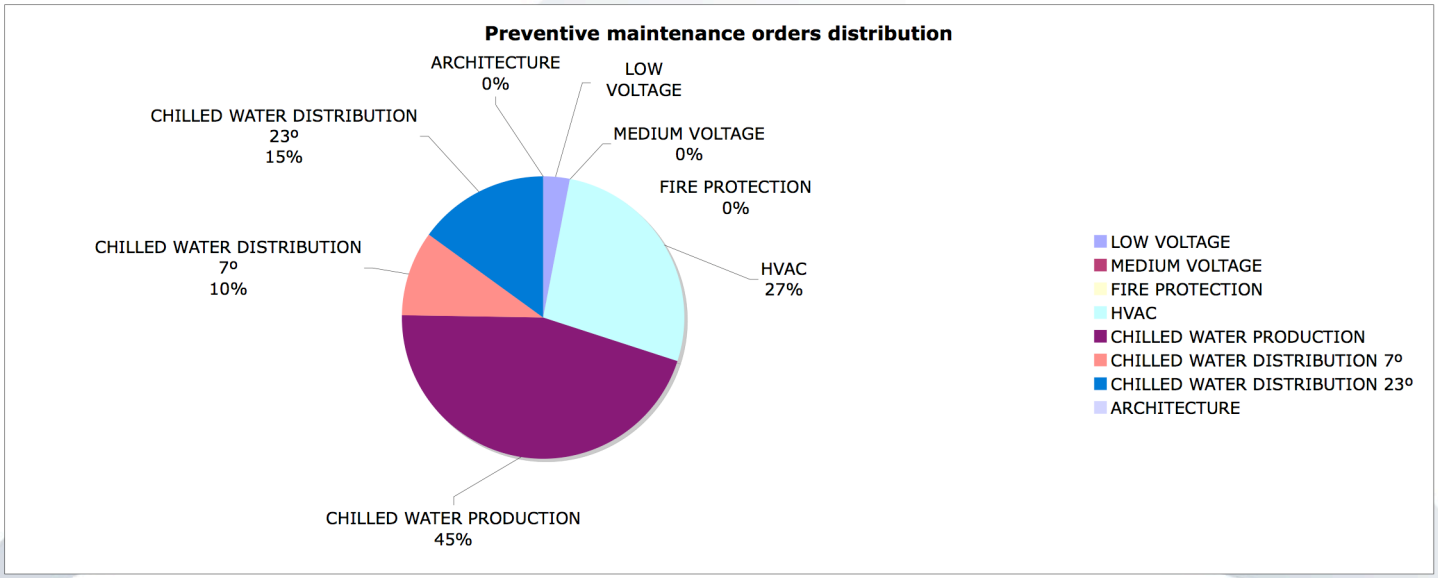
CLASS		TOTAL	CORRECTIVE	PREVENTIVE
LOW VOLTAGE	BT	185	170	15
MEDIUM VOLTAGE	MT	2	1	1
FIRE PROTECTION	CI	0	0	0
HVAC	CL	201	66	135
CHILLED WATER PRODUCTION	MP	261	33	228
CHILLED WATER DISTRIBUTION 7º	MD7	62	13	49
CHILLED WATER DISTRIBUTION 23º	MD23	90	15	75
ARCHITECTURE	A	128	128	0
TOTAL			426	503



CLASS		TOTAL	CORRECTIVE	PREVENTIVE
LOW VOLTAGE	BT	185	170	15
MEDIUM VOLTAGE	MT	2	1	1
FIRE PROTECTION	CI	0	0	0
HVAC	CL	201	66	135
CHILLED WATER PRODUCTION	MP	261	33	228
CHILLED WATER DISTRIBUTION 7º	MD7	62	13	49
CHILLED WATER DISTRIBUTION 23º	MD23	90	15	75
ARCHITECTURE	A	128	128	0
TOTAL			426	503



CLASS		TOTAL	CORRECTIVE	PREVENTIVE
LOW VOLTAGE	BT	185	170	15
MEDIUM VOLTAGE	MT	2	1	1
FIRE PROTECTION	CI	0	0	0
HVAC	CL	201	66	135
CHILLED WATER PRODUCTION	MP	261	33	228
CHILLED WATER DISTRIBUTION 7º	MD7	62	13	49
CHILLED WATER DISTRIBUTION 23º	MD23	90	15	75
ARCHITECTURE	A	128	128	0
TOTAL			426	503



Talk outline

- Overview of ALBA Building and utilities.
- Building and utilities current maintenance approach.
- **Vacuum systems current maintenance approach**
- Condition Based Maintenance introduction study

Objective. Maximum reliability at minimum cost

Strategy

Keep in-house all knowledge necessary to operate and maintain the system.

In-house management of the maintenance and exploitation of the vacuum system.

Optimize the maintenance/exploitation cost related to personnel, spares and reposition.

Scheme

Team of in-house technicians (2) and engineers (2) trained on vacuum technologies.

Outsourcing to specialized companies the routine maintenance of specific equipments. Corrective in function of volume.

Spares and components supply framework conditions with general and specialist suppliers (price and delivery time).

Objective, strategy and the scheme are very similar to those of the conventional infrastructures.

Apply the same methodologies that have been giving good results over the last three years of operation and maintenance of the conventional infrastructures

Implementation

Exhaustive inventory of all vacuum components and equipment.

Maintenance and technical data compilation, database consolidation.
Production of maintenance protocols when necessary.

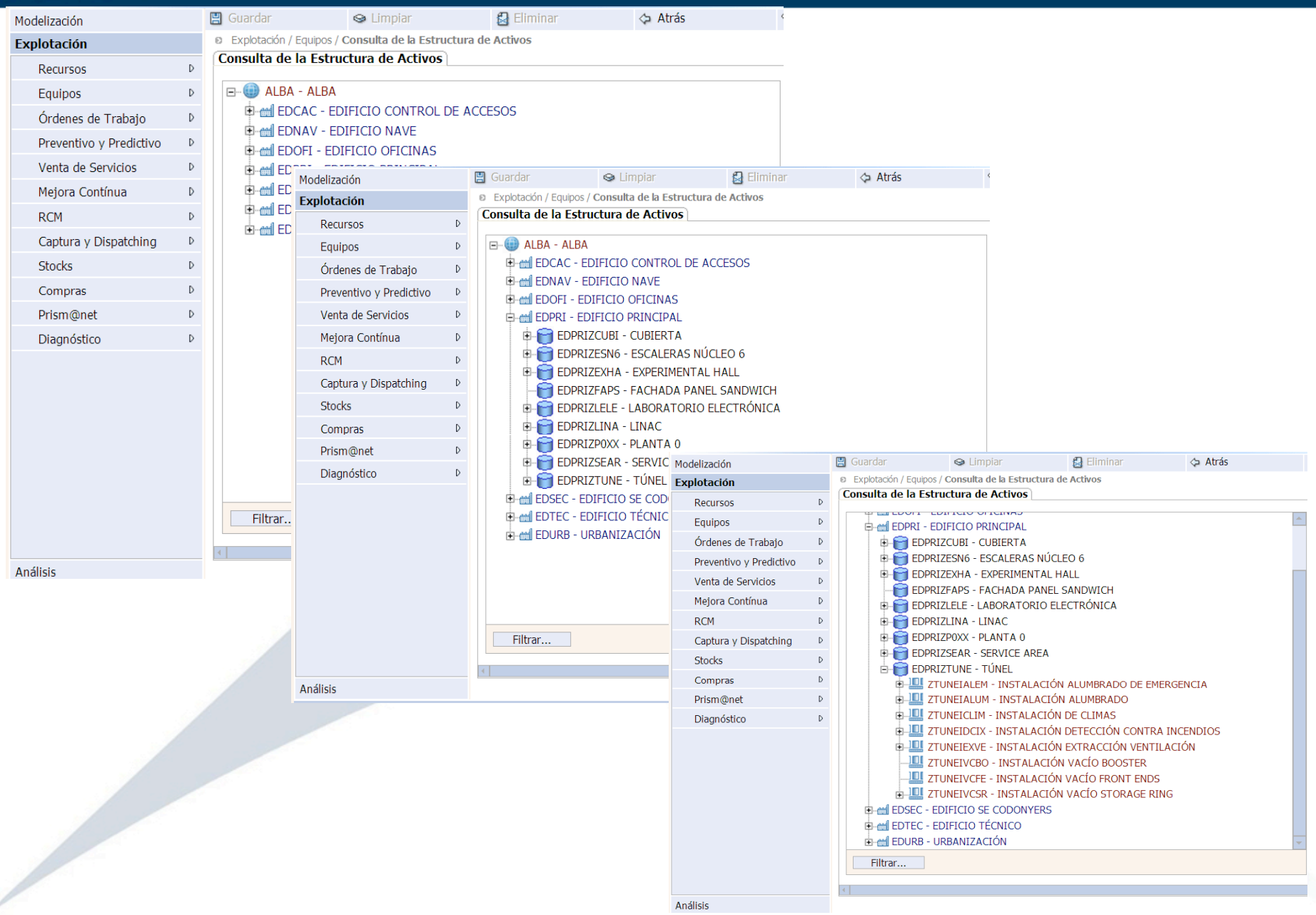
Implementation of vacuum systems on Prisma 3.

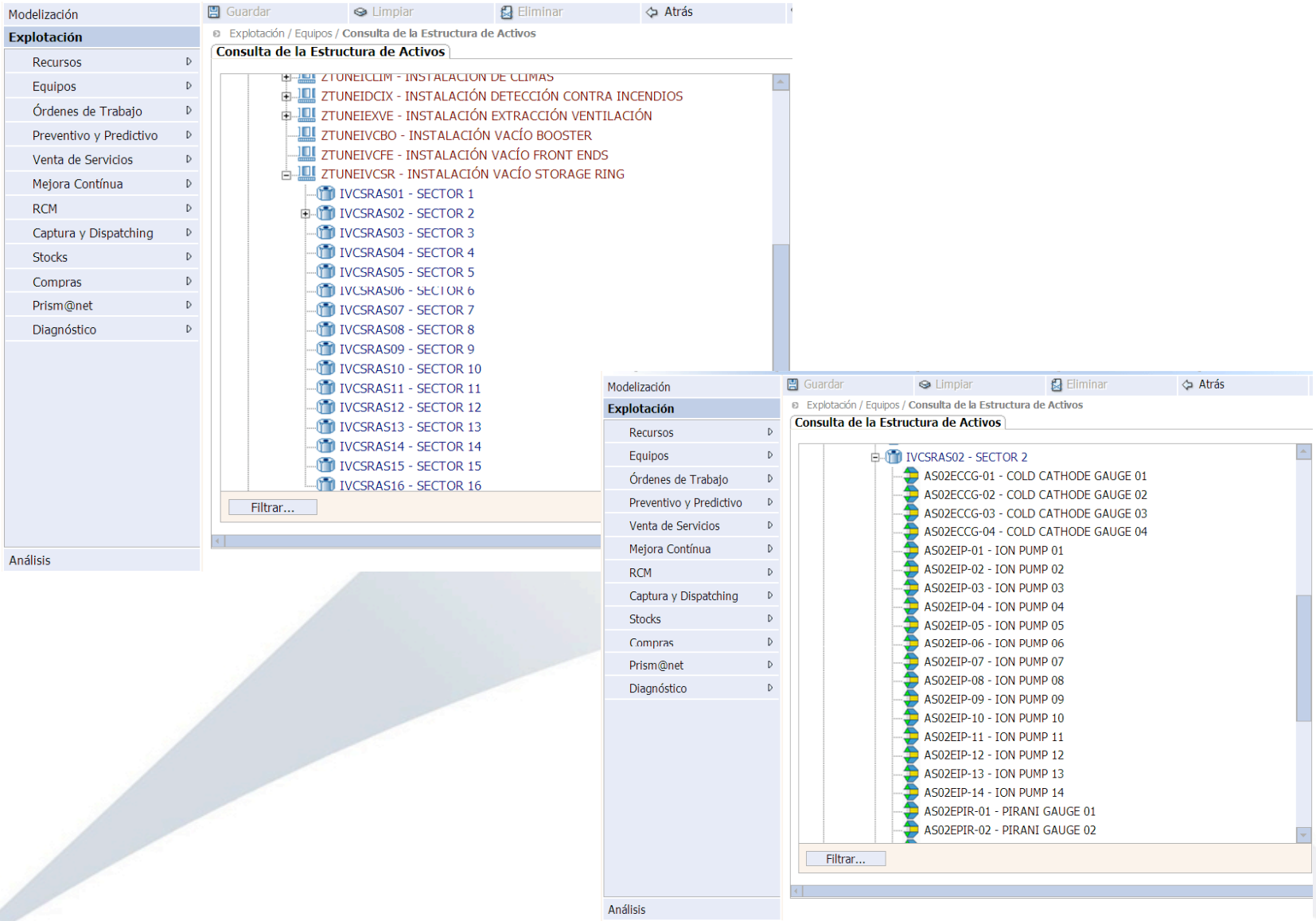
Implementation of maintenance protocols on Prisma 3.

Critical vacuum components list and minimum stock definition.

Vacuum components stocks inventory.

Integrated management of vacuum work orders, planning and stocks


Modelización
Explotación
Recursos
Equipos
Órdenes de Trabajo
Preventivo y Predictivo
Venta de Servicios
Mejora Contínua
RCM
Captura y Dispatching
Stocks
Compras
Prism@net
Diagnóstico
Análisis
Guardar
Limpiar
Eliminar
Atrás
Explotación / Equipos / Consulta de la Estructura de Activos
Consulta de la Estructura de Activos
ALBA - ALBA
EDCAC - EDIFICIO CONTROL DE ACCESOS
EDNAV - EDIFICIO NAVE
EDOFI - EDIFICIO OFICINAS
EDPRI - EDIFICIO PRINCIPAL
EDPRIZCUBI - CUBIERTA
EDPRIZESN6 - ESCALERAS NÚCLEO 6
EDPRIZEXHA - EXPERIMENTAL HALL
EDPRIZFAPS - FACHADA PANEL SANDWICH
EDPRIZLELE - LABORATORIO ELECTRÓNICA
EDPRIZLINA - LINAC
EDPRIZP0XX - PLANTA 0
EDPRIZSEAR - SERVICE AREA
EDPRIZTUNE - TÚNEL
ZTUNEIALEM - INSTALACIÓN ALUMBRADO DE EMERGENCIA
ZTUNEIALUM - INSTALACIÓN ALUMBRADO
ZTUNEICLIM - INSTALACIÓN DE CLIMAS
ZTUNEIDCIX - INSTALACIÓN DETECCIÓN CONTRA INCENDIOS
ZTUNEIEXVE - INSTALACIÓN EXTRACCIÓN VENTILACIÓN
ZTUNEIVCBO - INSTALACIÓN VACÍO BOOSTER
ZTUNEIVCFE - INSTALACIÓN VACÍO FRONT ENDS
ZTUNEIVCSR - INSTALACIÓN VACÍO STORAGE RING
EDSEC - EDIFICIO SE CODONYERS
EDTEC - EDIFICIO TÉCNICO
EDURB - URBANIZACIÓN
Filtrar...


Modelización
Explotación
Recursos
Equipos
Órdenes de Trabajo
Preventivo y Predictivo
Venta de Servicios
Mejora Contínua
RCM
Captura y Dispatching
Stocks
Compras
Prism@net
Diagnóstico
Análisis
Guardar
Limpiar
Eliminar
Atrás
Explotación / Equipos / Consulta de la Estructura de Activos
Consulta de la Estructura de Activos
ZTUNEICLIM - INSTALACIÓN DE CLIMAS
ZTUNEIDCIX - INSTALACIÓN DETECCIÓN CONTRA INCENDIOS
ZTUNEIEXVE - INSTALACIÓN EXTRACCIÓN VENTILACIÓN
ZTUNEIVCBO - INSTALACIÓN VACÍO BOOSTER
ZTUNEIVCFE - INSTALACIÓN VACÍO FRONT ENDS
ZTUNEIVCSR - INSTALACIÓN VACÍO STORAGE RING
IVCSRAS01 - SECTOR 1
IVCSRAS02 - SECTOR 2
IVCSRAS03 - SECTOR 3
IVCSRAS04 - SECTOR 4
IVCSRAS05 - SECTOR 5
IVCSRAS06 - SECTOR 6
IVCSRAS07 - SECTOR 7
IVCSRAS08 - SECTOR 8
IVCSRAS09 - SECTOR 9
IVCSRAS10 - SECTOR 10
IVCSRAS11 - SECTOR 11
IVCSRAS12 - SECTOR 12
IVCSRAS13 - SECTOR 13
IVCSRAS14 - SECTOR 14
IVCSRAS15 - SECTOR 15
IVCSRAS16 - SECTOR 16
Filtrar...
Modelización
Explotación
Recursos
Equipos
Órdenes de Trabajo
Preventivo y Predictivo
Venta de Servicios
Mejora Contínua
RCM
Captura y Dispatching
Stocks
Compras
Prism@net
Diagnóstico
Análisis
Guardar
Limpiar
Eliminar
Atrás
Explotación / Equipos / Consulta de la Estructura de Activos
Consulta de la Estructura de Activos
IVCSRAS02 - SECTOR 2
AS02ECCG-01 - COLD CATHODE GAUGE 01
AS02ECCG-02 - COLD CATHODE GAUGE 02
AS02ECCG-03 - COLD CATHODE GAUGE 03
AS02ECCG-04 - COLD CATHODE GAUGE 04
AS02EIP-01 - ION PUMP 01
AS02EIP-02 - ION PUMP 02
AS02EIP-03 - ION PUMP 03
AS02EIP-04 - ION PUMP 04
AS02EIP-05 - ION PUMP 05
AS02EIP-06 - ION PUMP 06
AS02EIP-07 - ION PUMP 07
AS02EIP-08 - ION PUMP 08
AS02EIP-09 - ION PUMP 09
AS02EIP-10 - ION PUMP 10
AS02EIP-11 - ION PUMP 11
AS02EIP-12 - ION PUMP 12
AS02EIP-13 - ION PUMP 13
AS02EIP-14 - ION PUMP 14
AS02EPIR-01 - PIRANI GAUGE 01
AS02EPIR-02 - PIRANI GAUGE 02
Filtrar...

Talk outline

- Overview of ALBA Building and utilities.
- Building and utilities current maintenance approach.
- Vacuum systems current maintenance approach
- **Condition Based Maintenance introduction study**

Motivation to explore the viability of CBM approach implementation

- Particularities of the scientific research facilities operation and design (fast variable load, high availability, redundancy,..) brings to an scenario where the conventional industrial approach to maintenance is not adequate.

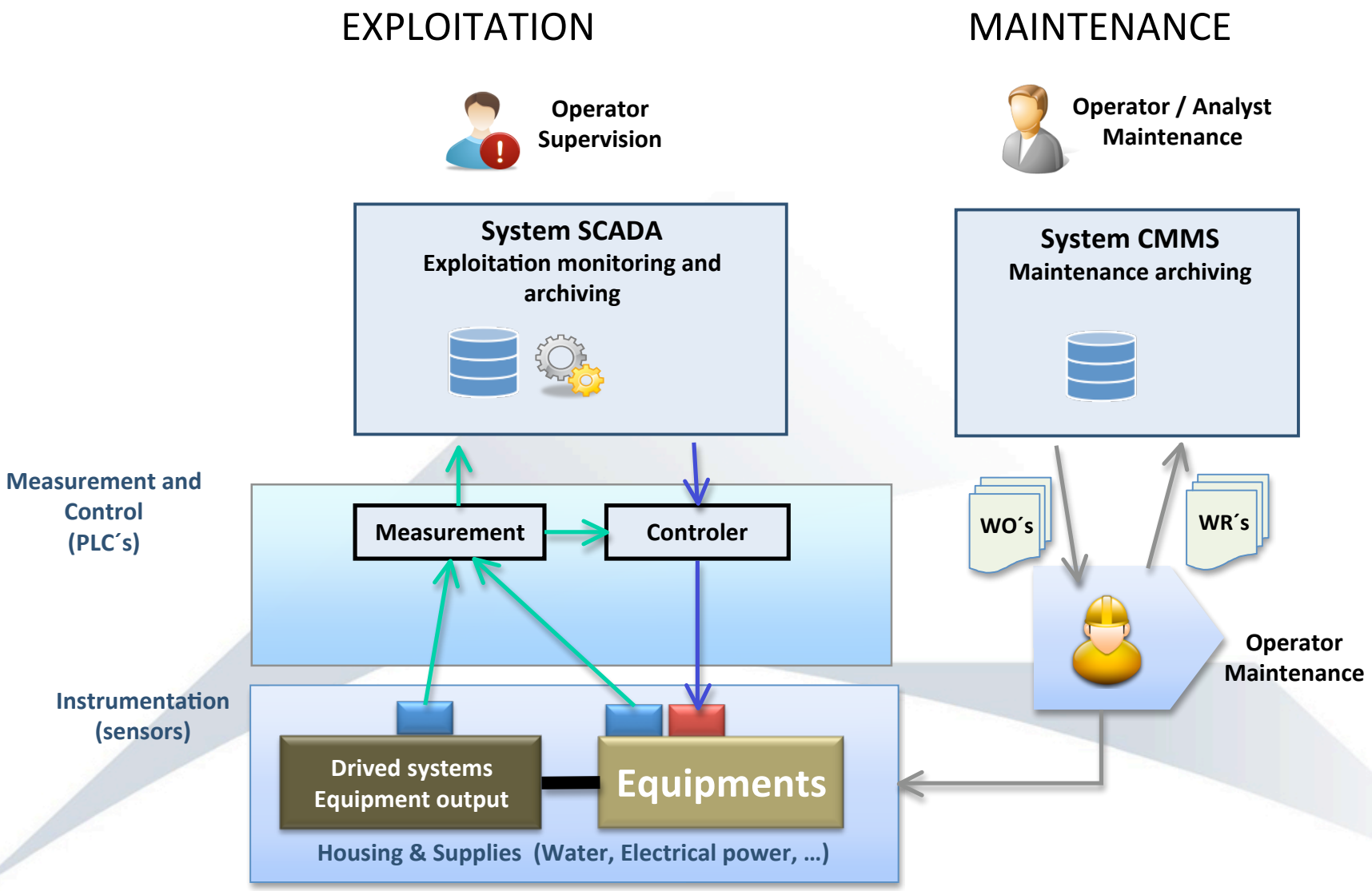
- Increase reliability.

- Decrease cost.

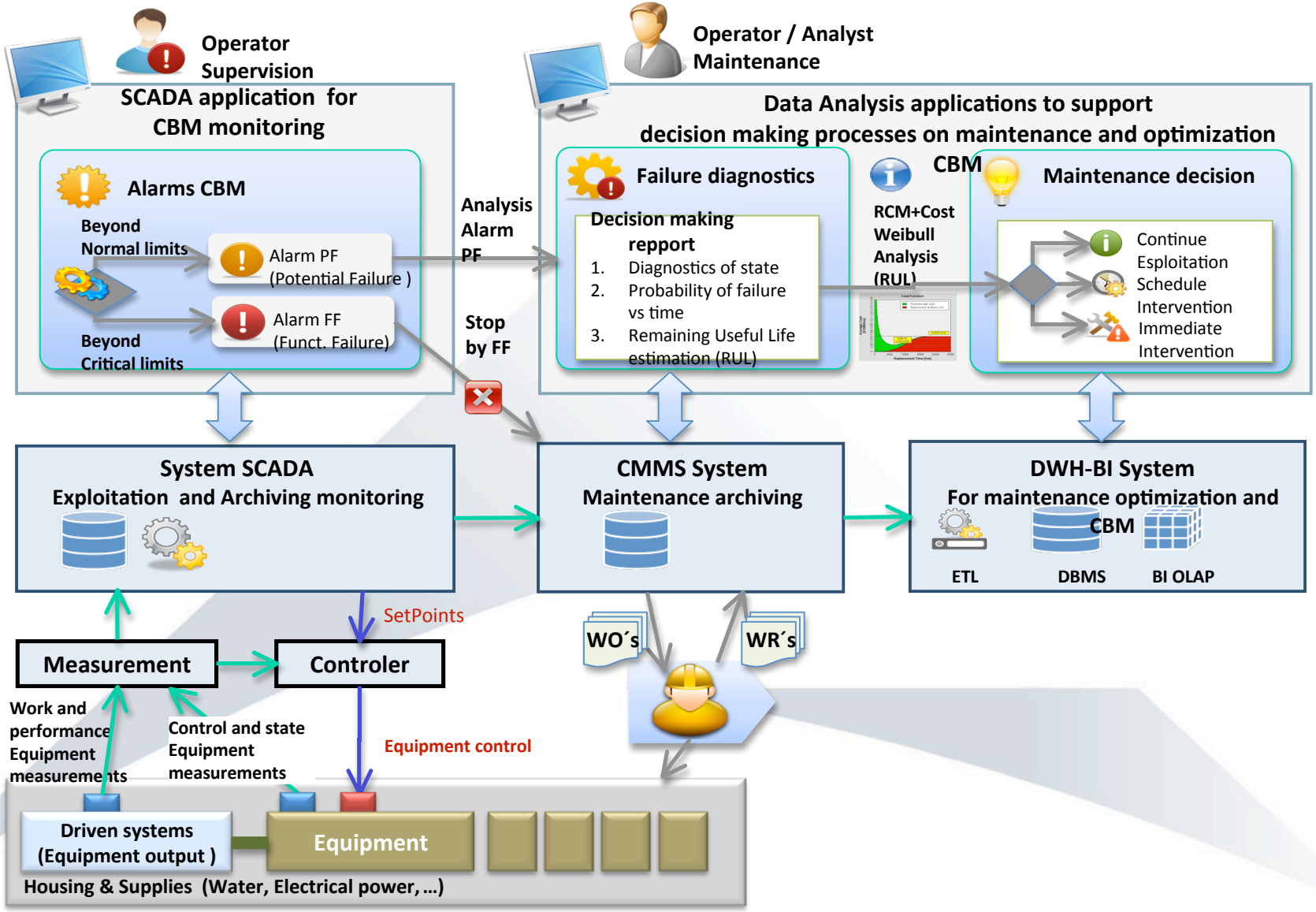
- Decrease at minimum not programmed shutdowns.

- Increase predictability to optimize the programmed shutdown activities.

Context for a CBM system



CBM system – Conceptual Architecture



Main requests to the system wrt failures.

- measure
- control
- alarm generation
- archiving
- diagnostic
- support to maintenance decisions

Three modules are defined.

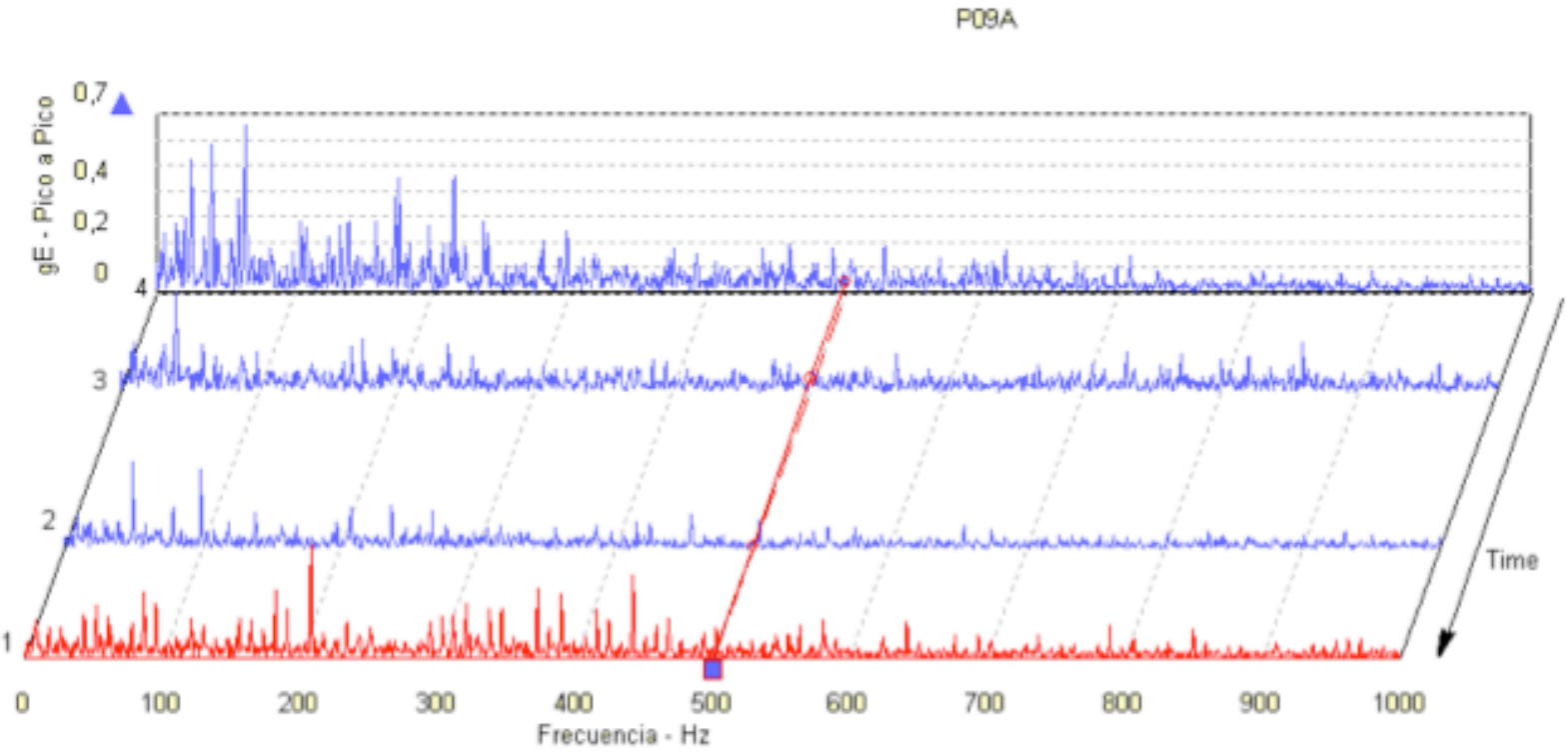
- Measure system
- Alarm and diagnostic system
- Support to decision system

Modules to be implemented in the framework of the operations (SCADA) and maintenance (CMMS) ALBA scheme

The pumps of the cooling and HVAC systems are choose as study case. Motivation

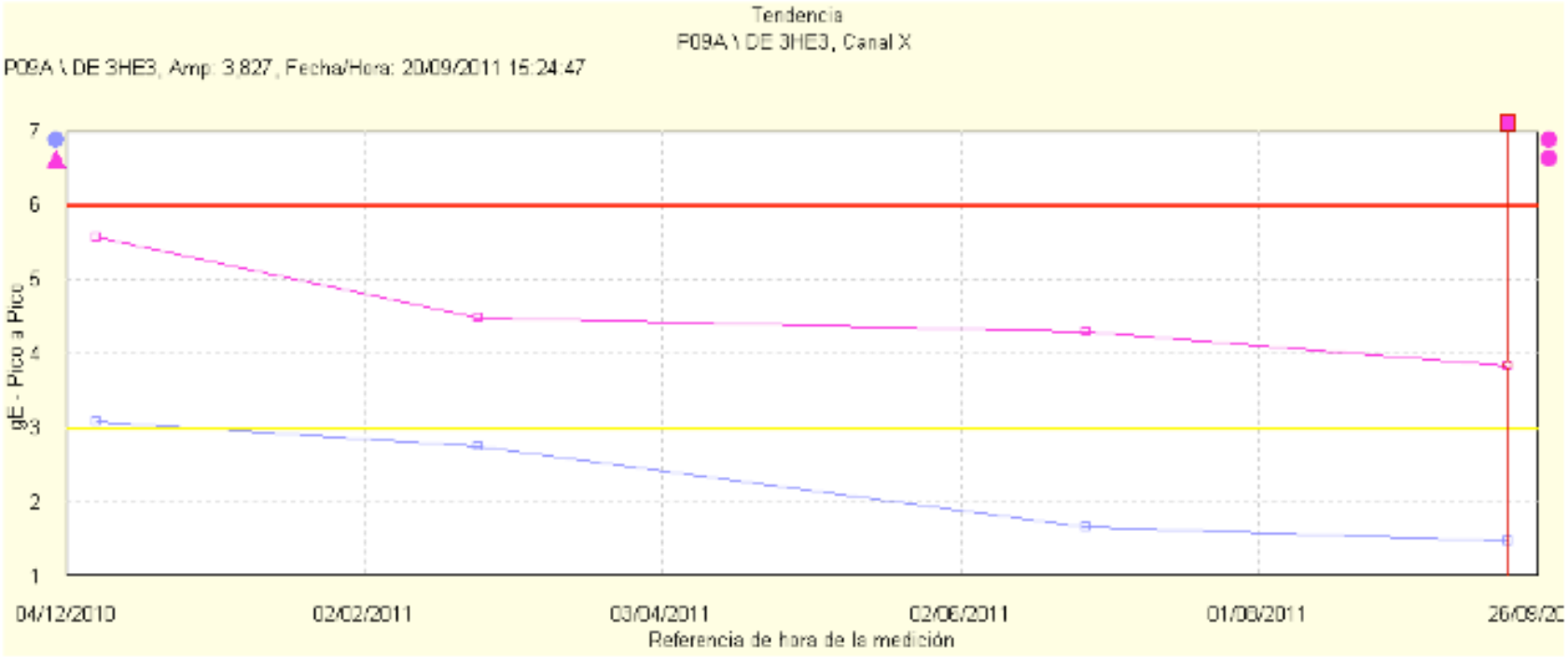
- critical for the facility
- literature availability
- real data availability

Exemple de espectre de vibracions de la bomba P09A en les quatre últimes mesures.



1 (vermell) → variadors de frequencia
2 → despres de reparació
3 → Després alineacio
4 → Estat a inici any

Evolució de vibració global de la bomba P09A en les ultimes 4 medicions.



Alarm generation and failure diagnostic system.

- alarm generation embedded in in the control system, generated from internal and external parameters

- the limits of the parameters deviate from the control range, a potential failure alarm is generated. The alarm shall be considered wrt the historical data from the CMMS (work orders knowledge) and RCM (Reliability Condition Maintenance, reliability knowledge).

- the limits of the parameters deviate from the control range up to a critical level, a functional failure alarm is generated that implies the emergency stop of the equipment.

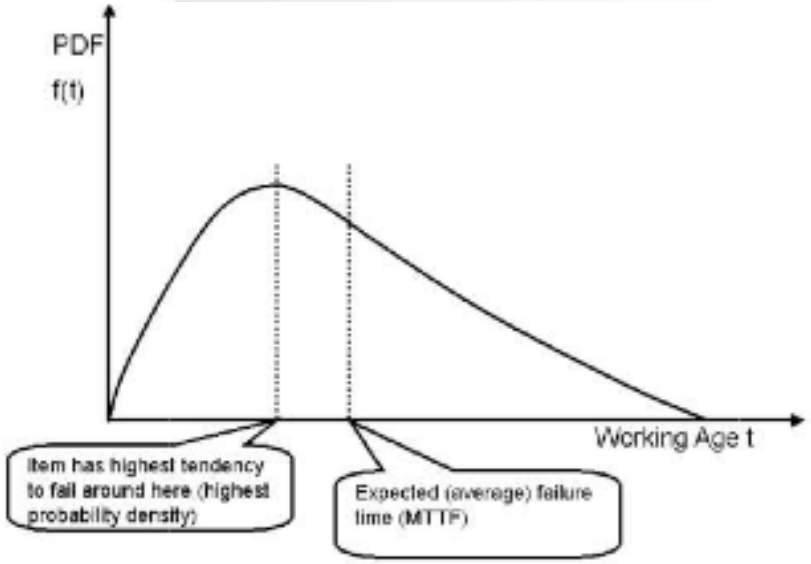


Figure 2 La función de densidad de probabilidad de fallo

Data Collection

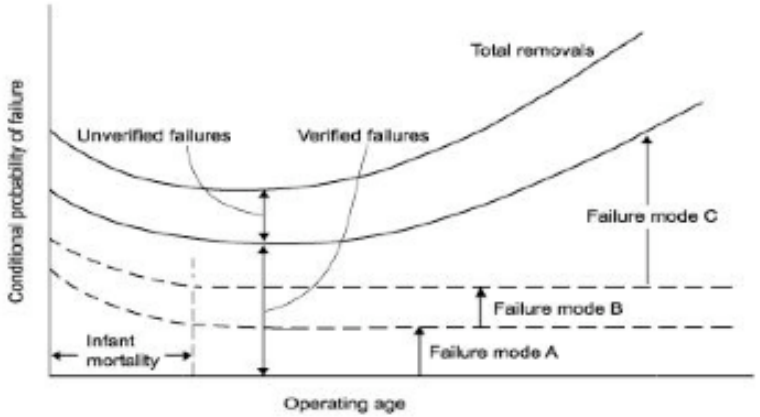


Figure 3 La probabilidad condicionada de fallo

Failure analysis

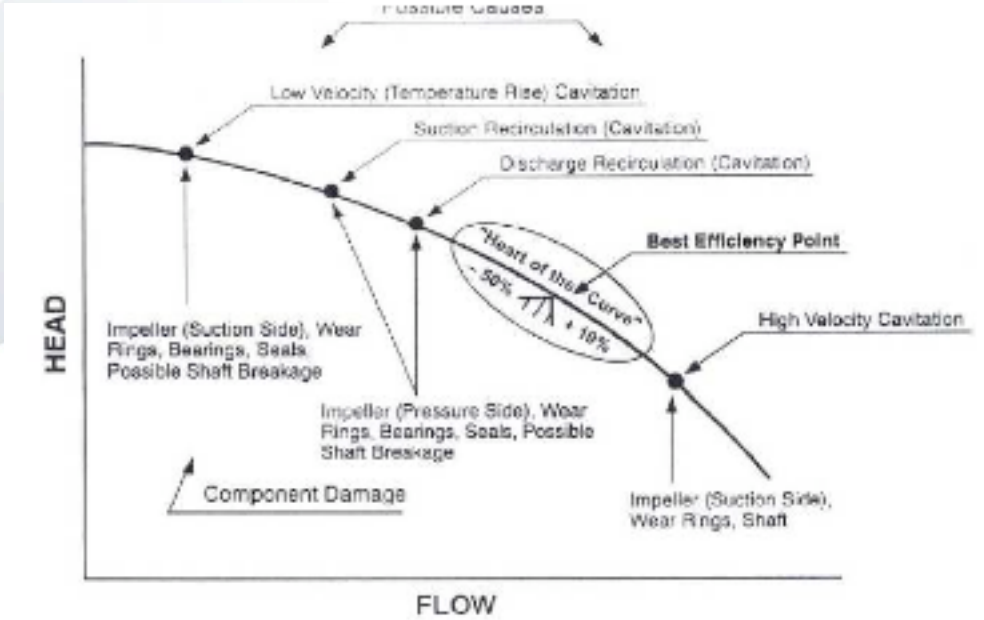


Figure 4 Gráfica para el análisis de causas de fallo según el punto de trabajo operativo de la bomba

Support to decision system. Once a potential failure alarm has been generated the system shall combine the following information

- component diagnostics based on the operative measurements of the component and the process.
- information about the lifetime behaviour of the component (CMMS historical data)
- Failure probability in the future. Weibull analysis.
- Estimation of remaining lifetime
- Data on the cost associated to unexpected failure and preventive maintenance.

Graphs are generated to asses the decision making process

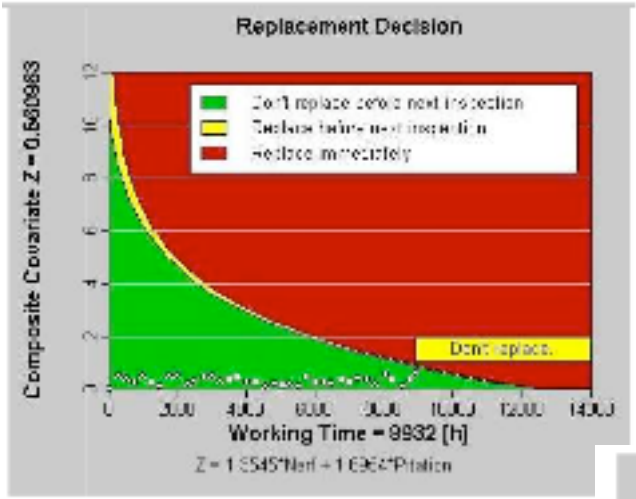


Figure 5 A Replacement Decision Report

Green. Continue operation

Yellow. Plan intervention

Red. Emergency intervention

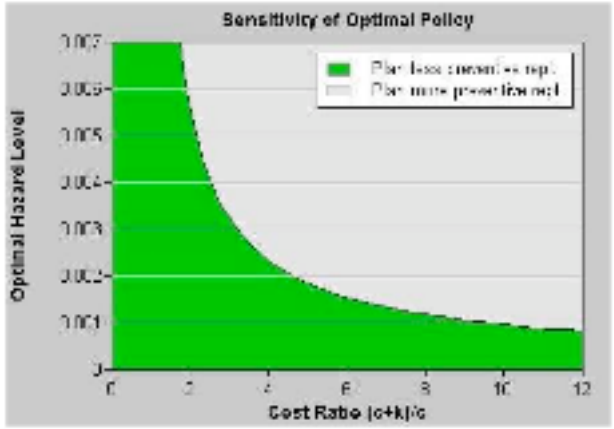


Figure 6 A Sensitivity of Optimal Policy Report

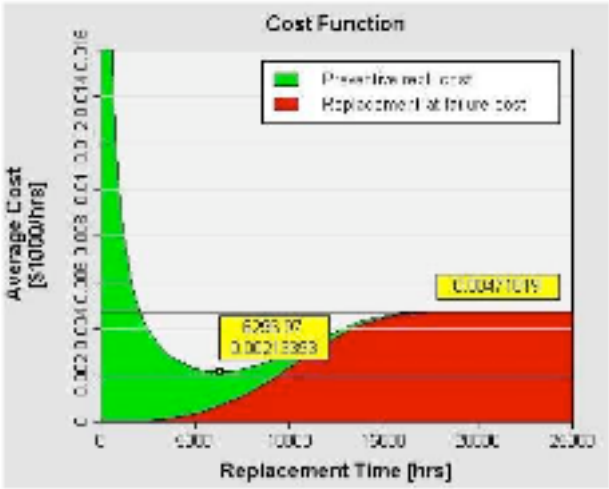


Figure 7 A Cost Function Report

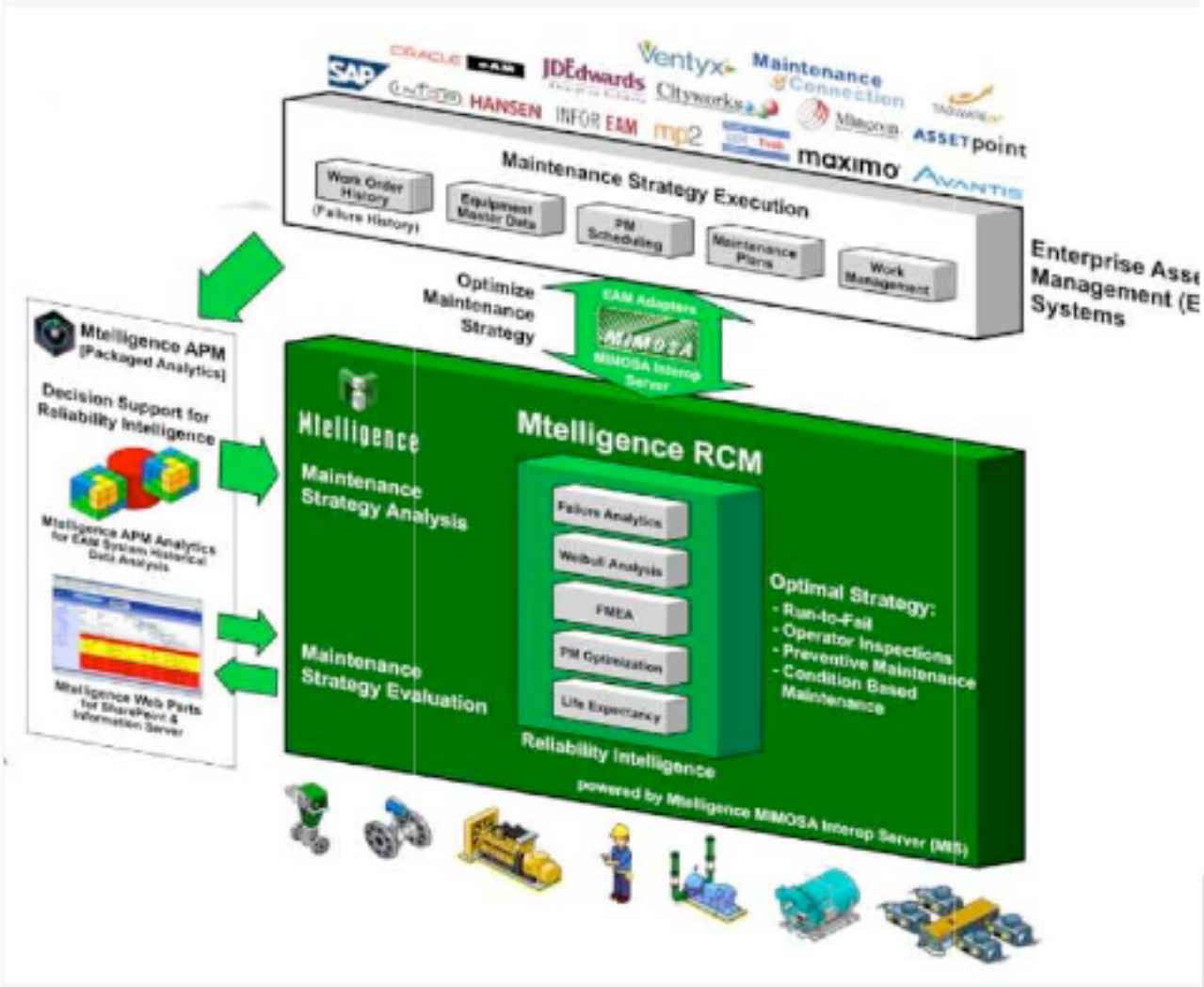


Figure 8 Mtelligence RCM

Current status.

- Commercial available software market survey done. Benchmarking going on.
- Data mining subroutines for the scada data extraction ready
- Vibrations analysis hardware market survey done and equipment selected.
- Collecting work orders data.
- In parallel, looking at the convenience of applying the methodology to scientific equipment (i.e. Power converters, vacuum system)

THANK YOU FOR YOUR ATTENTION

WATER TREATMENT

REQUERIMENTS:
Input temperature of the circuit in the ALBA tunnel, 23 ± 0.2°C.
Thermal loads to be dissipated by the water.
Circulation flow rates and pressure
Water with great purity, maximum conductivity of 0.20 µS/cm.
Filtered to 10 µ (micron)
Volume ring circuits about 100 m³, 4 closed rings with common return.

CHOSEN SOLUTION: decalcified units plus reverse osmosis equipment. More ecological in regard to the residual water but great attention, maintenance and care of the membranes.
•Characteristics parameters of the INLET water supply from the urbanization net in Cerdanyola. (Barcelona)
•Decalcified unit, maximum production of 27 m3/h.
•Osmotic water production capacity of 2,5 m3/h.
•2.000 l/h flow for maintenance of membranes.

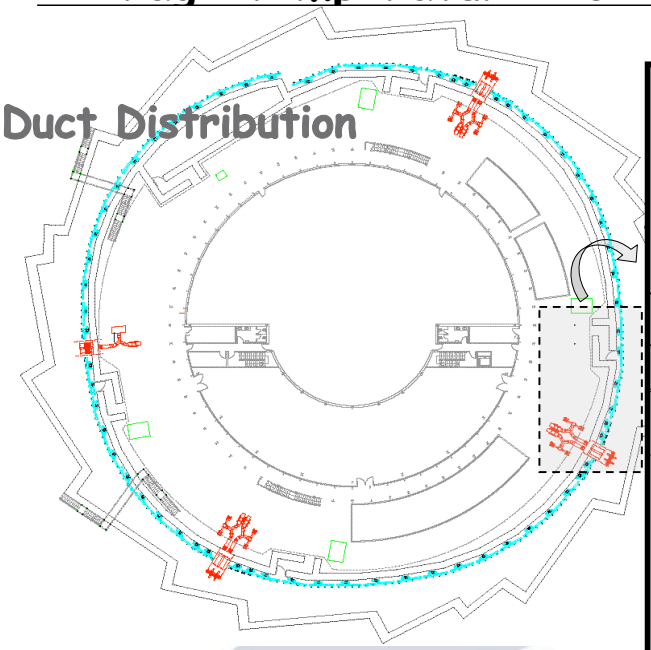
AIR CONDITIONING

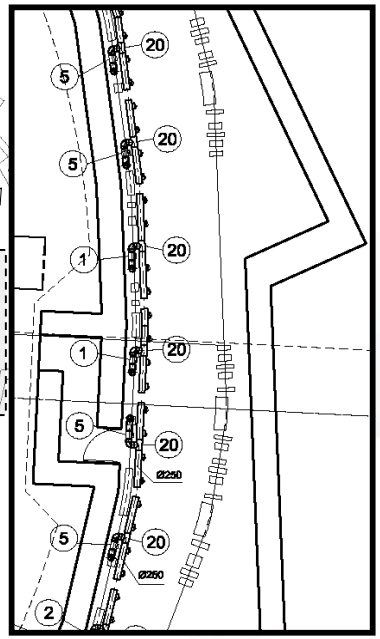
ALBA Tunnel: turbulent flow system.

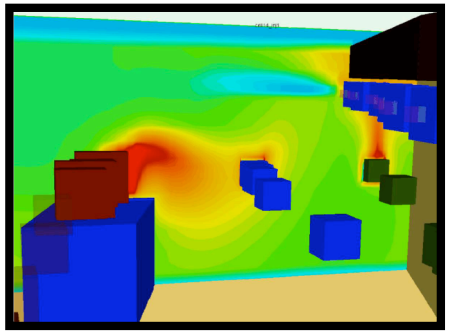
FIVE AIR CONDITIONING WITH COOLING CAPACITY OF 200 Kw, TOTAL AIR FLOW 68.000 m^3/h

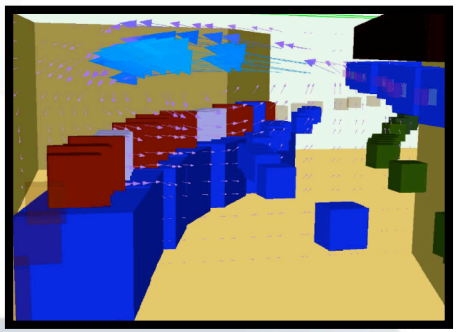
Average temperature 23°C, variation Tmax-Tmin < 0'2°C

Duct Distribution









Hall Experimental: displacement flow system.

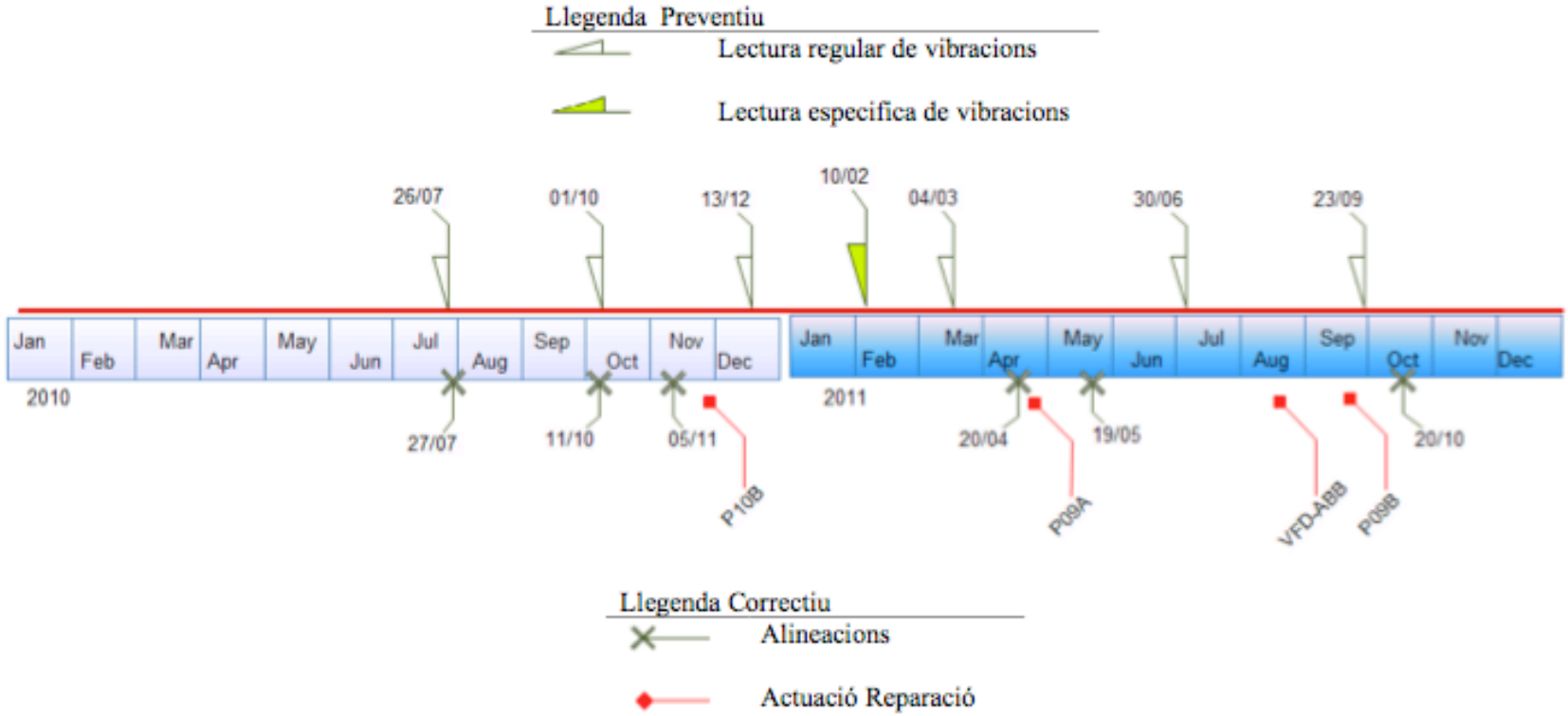
SIX AIR CONDITIONING WITH COOLING CAPACITY OF 1,160 Kw AND HEATING CAPACITY OF 450 Kw. TOTAL AIR FLOW IS 240.000 m3/h AND EQUIPPED WITH FREECOLING SYSTEM AND HUMIDIFIER BY SPRAYING

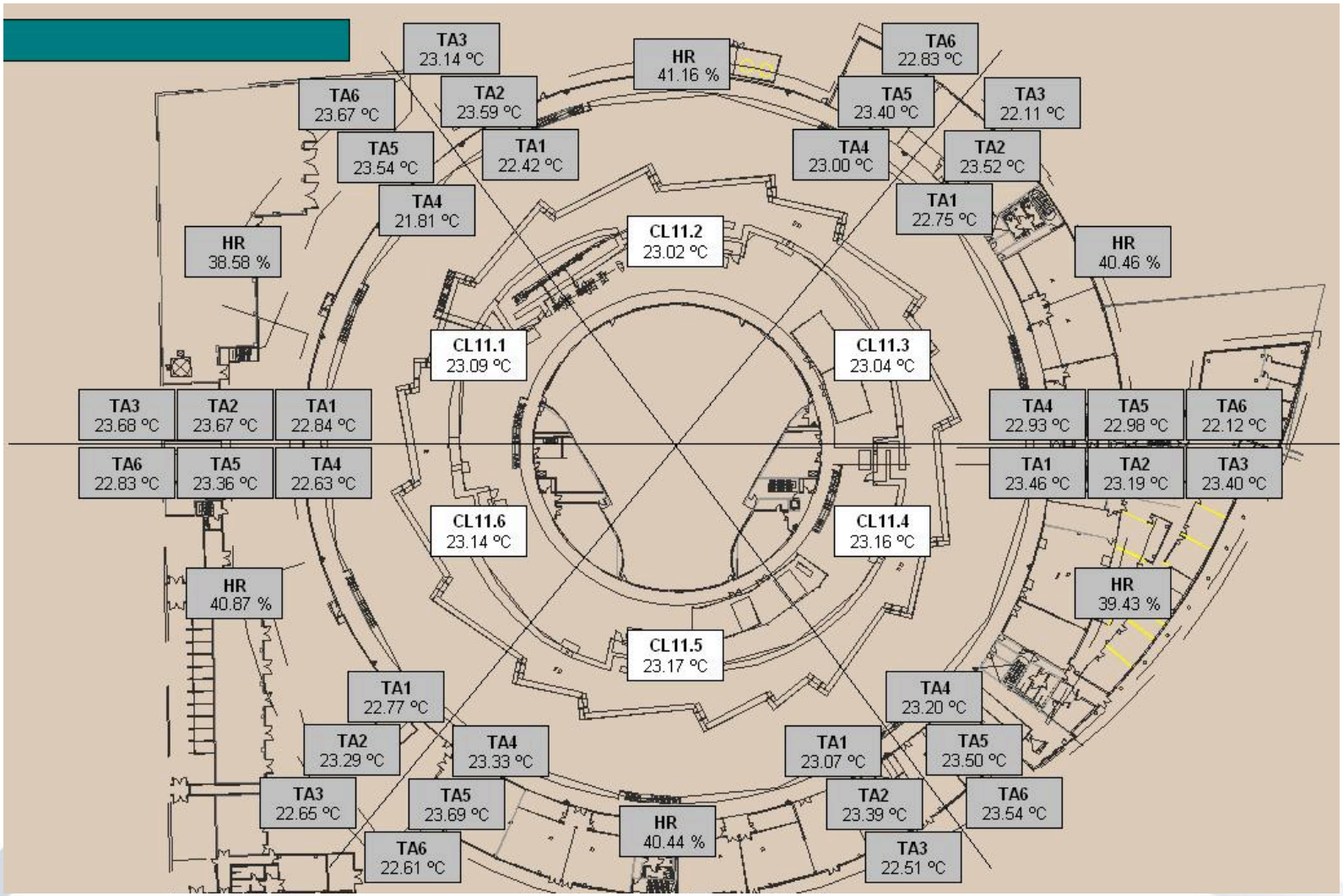
Average temperature 23°C, variation Tmax-Tmin < 1°C

Measure system. Shall combine information coming from the instrumentation associated to the control utilities system and information coming from the field. The parameters considered are:

- pressure
- flow
- vibrations
- temperature
- power consumption
- Torque and rotation speed

Registre:


Llegenda Preventiu
Lectura regular de vibracions
Lectura especifica de vibracions
26/07
01/10
13/12
10/02
04/03
30/06
23/09
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
2010
2011
27/07
11/10
05/11
P10B
20/04
P09A
19/05
VFD-ABB
P09B
20/10
Llegenda Correctiu
Alineacions
Actuació Reparació

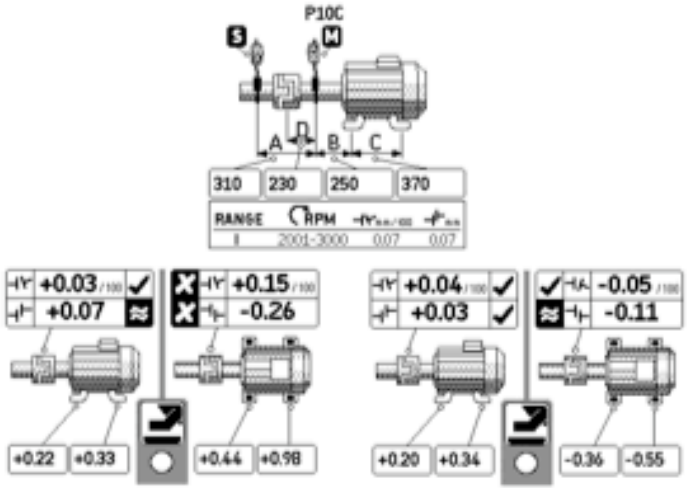

TA3 23.14 °C
HR 41.16 %
TA6 22.83 °C
TA6 23.67 °C
TA2 23.59 °C
TA5 23.40 °C
TA3 22.11 °C
TA5 23.54 °C
TA1 22.42 °C
TA4 23.00 °C
TA2 23.52 °C
TA4 21.81 °C
TA1 22.75 °C
HR 38.58 %
CL11.2 23.02 °C
HR 40.46 %
CL11.1 23.09 °C
CL11.3 23.04 °C
TA3 23.68 °C
TA2 23.67 °C
TA1 22.84 °C
TA4 22.93 °C
TA5 22.98 °C
TA6 22.12 °C
TA6 22.83 °C
TA5 23.36 °C
TA4 22.63 °C
TA1 23.46 °C
TA2 23.19 °C
TA3 23.40 °C
CL11.6 23.14 °C
CL11.4 23.16 °C
HR 40.87 %
HR 39.43 %
CL11.5 23.17 °C
TA1 22.77 °C
TA4 23.20 °C
TA2 23.29 °C
TA4 23.33 °C
TA1 23.07 °C
TA5 23.50 °C
TA3 22.65 °C
TA5 23.69 °C
TA2 23.39 °C
TA6 23.54 °C
HR 40.44 %
TA6 22.61 °C
TA3 22.51 °C

Actuacions de reparació:

- P10B
- P09A
- Variadors de freq. a les 12 bombes.
- P09B

Alineació (2010- 2011)

	P08B	P08C	P09A	P10A	P10B	P10C	P11A	P11B
1.		x					x	x
2.								x
3.				x	x			
4.	x	x		x	x			x
5.			x					
6.						x		



Abans

després

Classificació Norma ISO-10816-3-2009

Severity		Range Limits and Machine Classes ISO Standard 10816-3 (2009)				Severity	
r.m.s. displacement µm	r.m.s. velocity mm/s	Group 2: Medium Sized Machines		Group 1: Large machines		r.m.s. velocity mm/s	r.m.s. displacement µm
		Rigid	Flexible	Rigid	Flexible		
22	1.4	A	A	A	A	2.3	29
37	2.3	B					
45	2.8		B	B		3.5	45
71	4.6	C			B	4.5	57
113	7.1		C	C		7.1	90
		D	D	D	C	11.0	140
					D		

Presentació estandar dels resultats seguint la norma ISO

TABLA 1
Severidad en las ubicaciones siguientes de planta:

PLANTA	UBICACIÓN	ESTADO		
		Anterior	Actual	Alarma
AREA EXP	P07A	1	0	
	P07B	3	0	
STORAGE	P08A	3	3	
	P08B	3	3	
	P08C	1	3	
BOOSTER	P09A	3	3	
	P09B	1	1	A2
AREA SERVEI	P10A	3	3	
	P10B	1	1	A2
	P10C	1	1	A2
RETORN	P11A	3	3	
	P11B	3	3	
UTA´S TUNEL	P12A	3	3	
	P12B	3	3	
UTA´S BL	P13A	3	3	
	P13B	3	0	
UTA´S EXP	P14A	3	0	
	P14B	3	3	
UTA´S LABS OFF	P15A	3	3	
	P15B	3	0	
	P15C	3	3	

PLANTA	UBICACIÓN	ESTADO		
		Anterior	Actual	Alarma
UTA´S AREA EXP	P17A	3	3	
	P17B	3	0	
UTA´S LAB OFF	P18A	3	0	
	P18B	0	3	
INTER-TORRES	P20A	0	0	
	P20B	0	0	
FRED-COGEN	P30A	3	3	
	P30B	3	3	
	P30C	3	0	
CALOR - COGENER	P31A	2	3	
	P31B	3	0	

1	A2	Equipo en condiciones severas de vibración. Intervención inmediata.
	A1	Equipo con valores de vibración en estado de alarma. Seguimiento e intervenciones a medio/corto plazo.
2		Equipo en observación. Esperar a conocer su evolución.
3		Equipo en funcionamiento normal.
0		Equipo sin medición.